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Piano Plate Foundry is Distinctive

Cupola is Located in Center of Molding Floor for Convenience of Molders Carrying Iron—All Metal Poured From Hand Ladles—Shop Drills and Bronzes the Castings

SOME branches of foundry activity differ in many essentials from the remainder of the industry. Many of these lines of endeavor have developed quietly and little is heard of their improvements. They were brought to a high standard of efficiency years ago not through any marked innovations in their processes, but by small steps effective only in the aggregate. The manufacture of cast-iron piano plates is an example of this evolution of a specialized foundry art. This industry was started years ago and the general plan of molding the plates at first employed still is largely in vogue with only minor changes in the methods.

The character of the casting and the exacting requirements for the product limit the molding procedure. About 10 years ago a firm starting to make piano plates installed molding machines, but it is difficult to convince many who have been molding piano plates on the floor for years that a satisfactory article can be turned out in any other way.

One of the foundries which has kept to floor molding is the Superior Foundry Co., Cleveland. This company operates a general jobbing shop, including in its organization three distinct branches. One department is set aside for heavy work only; another large division makes medium and light castings; and still another is devoted to piano plates. These sections are operated almost as distinct foundries, each having its superintendent who is responsible for the output and in no way is dependent on either of the other two departments.

The features which distinguish the work of the piano-plate foundry are

FIG. 1—PIANO-PLATE CASTINGS ARE SO THIN AND COVER SUCH A LARGE AREA THAT MANY GATES ARE REQUIRED TO CAST THEM—EVERY GATE IS POURED WITH A SEPARATE HAND LADLE—A SINGLE RISER IS USED ON EACH PLATE

the necessity for producing a large thin casting which will be perfectly flat and not vary greatly in thickness. Also, these castings must be easily machinable, as many holes are drilled, in which pins are set. The difficulty of obtaining soft iron regularly in these castings is accentuated by the light thin sections of the piano plates which sometimes are only ¼-inch thick. The general design of all plates is along the same lines and therefore there is little variation in the work from day to day.

FIG. 2—MOLDS ARE MADE IN ROWS UNDER WHICH ARE STRIPS OF CONCRETE—EACH LINE OF FLASKS IS COVERED BY A HAND-OPERATED CRANE

Two features, difficulty of molding and regularity of output, govern in training molders. A man who has worked on other molding work can not step into a piano plate foundry and produce good castings at once. He first must acquire experience in this particular line. This factor, with the regularity of the work from one week to the next, causes most of the molders not accustomed to the work to dislike it. Therefore, piano-plate foundries, usually train their own molders. This is done by giving each molder a helper who gradually acquires skill and ultimately becomes a molder.

The Superior Foundry Co. makes piano plates for a large number of piano makers and might be said to do a jobbing business in these castings. About 400 plates are made each day. An order is started by sending a drawing of the plate to the foundry. From this drawing a wood master pattern is made. A plate is cast from the master pattern, and an iron pattern is made by scraping and filing this plate to extreme accuracy. The care necessary in molding the wood master pattern to make the iron pattern is illustrated by the fact that a half day is required to make the mold, while nine molds are made in a day from iron patterns in the regular foundry work.

Before work is started from the iron pattern a sample casting is made from it and sent to the firm ordering the plates. If this first casting is approved by them the iron pattern is put into the sand and the wood master pattern is kept in pattern storage for use in case it becomes necessary at any time to make a second iron pattern.

The metal pattern is laid on a follow board and a thin layer of facing sand is sifted over it. Then a layer of molding sand is added and tucked around the pattern by hand. The final layer of sand is tamped by the molders with their feet. Skill is acquired in moving the length of the flask and ramming the sand rapidly by tramping over the surface with their shoes. Once over the entire mold in this manner serves to finish the ramming. The bottom board is clamped to the flask, the flask is lifted off the follow board and turned to its position. After the gate pins are set, the cope is rammed in a manner similar to the method employed in ramming the drag.

Crane Serves Each Floor

The drag is lifted from the cope as shown to the left in Fig. 2. A crane which serves the work travels on an I-beam the entire length of each floor. It easily is pushed along the runway by hand. The pulley is raised by two hand wheels on either side, operated by the molder and his helper. A ratchet prevents the pulley from falling. The ratchet is disengaged when it is desired to lower the pulley. The speed at which the pulley falls is regulated by a brake. The brake lever may be seen, protruding to the left of the frame slightly above one of the hand wheels.

After the cope is lifted, the crane is pushed back out of the way. The crane in the second aisle from the front in Fig. 2 is shown holding a cope. The pattern has been drawn and is ready to be placed on a follow board for making another drag. When the pattern is laid on the follow board, the molder and helper tuck in the first layer of sand. Then the molder cuts the gates in the drag from which the cope has been lifted while the helper finishes ramming the second drag.

The molders are not satisfied to slick the drag as it lays after the cope has been lifted, but take the precaution to throw sand on the cope before the pattern is drawn. This sand is then rammed either by hand or with the feet, and the excess sand is scraped off the surface with a short, hand strike-off. The molder believes that it is necessary to add this extra sand to secure a tight joint. The mold is then slicked with a trowel and the pattern drawn.

By the time the gates are cut in the first drag, the helper has finished ramming the second drag. Then the cope is lowered on the first drag. The next step is to get a cope flask from the end of the molding floor and place it on the second drag. The crane then stands idle until it is time to raise the next cope. With this arrangement the molder leaves off molding to operate the crane only twice during the making of each mold, once when lifting the cope and again when closing the mold.

After the castings are poured the molder lifts the cope flasks with the crane and carries them to the front end of the molding floor ready for the next day's operations. The castings are carried to the cleaning room by trolleys running on a system of I-beams through the shop. Two castings are hooked to each trolley and easily can be pushed by one man. Under present arrangements in this shop the molders pour off, shake out and cut the sand. With this system, a molder and his helper make nine castings a day, but the company is contemplating a change by which the molders will not pour their molds and it is thought that two men will put up 14 molds a day.

Many Gates Used

A distinctive feature of piano-plate molds is the large number of pouring gates used. Every mold has from five to seven pouring gates and one riser. The riser is always near the center of the mold. The services of one man with a ladle is required at each gate to pour the mold, as the plates are poured from hand ladles. A drag ready to receive the cope is shown in Fig. 1. This illustrates the number of gates, showing their locations and the method of feeding the casting through several branches from each gate. As may be noted, only one core is used. This is small and makes a hole under the cross bar.

Straight castings are an essential in piano plate work. These only can be obtained by uncovering the casting toward the center of the mold soon after it has been poured. Considerable experience is necessary to be able to do this, so the responsibility for producing strictly straight castings is left to each molder. The molder is not paid for warped castings.

Cement strips in the floor under each row of flasks serve to hold the mold firm and level. The floor between the strips of cement is built up with sand. It is thought this is easier for the molder than if he had to walk on a cement floor.

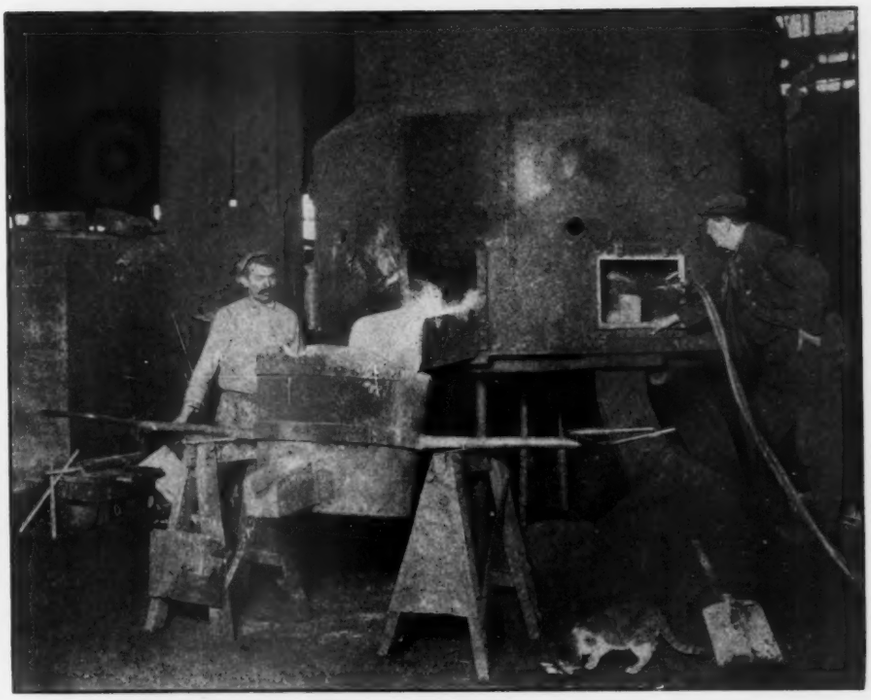


FIG. 3—THE CUPOLA IS LIGHTED WITH AN OIL BURNER—CLEAN IRON IS SECURED BY TAPPING THE RECEIVING LADLE FROM THE BOTTOM

Molding sand is an important element in securing clean castings. An open fine sand is necessary and Sandusky No. 2 sand answers the purpose well at this plant. This sand is fine yet so open that it is not necessary to use venting wires to make holes for carrying off the gas.

The iron for casting piano plates must produce soft strong castings and must be poured hot. The first two of these requirements are secured by regulating the composition. A comparatively high silicon iron with low phosphorus is used. The silicon will average near 2.5 per cent. Phosphorus is kept as low as possible consistent with a free running metal and will not go over 0.30 per cent. Care is used in purchasing coke of low sulphur content, and as no outside scrap is used the sulphur content of the iron is low.

To assure that the metal is not

FIG. 4—THE CUPOLA IS LOCATED IN THE CENTER OF THE MOLDING FLOOR—METAL AND COKE ARE BROUGHT TO THE CHARGING PLATFORM ALONG TWO STEEL RUNWAYS—THE RUNWAY FOR THE COKE MAY BE NOTED IN THE UPPER PART OF THE ILLUSTRATION

FIG. 5—A LARGE NUMBER OF MEN ARE EMPLOYED TO DRILL THE PLATES—FORTY MINUTES ARE REQUIRED TO DRILL ALL OF THE NUMEROUS HOLES IN ONE PLATE

cooled in carrying it from the furnace to the molds, the cupola is located in the center of the shop. The iron and coke are brought to it through long runways, extending from one corner of the foundry to a strongly supported steel platform around the cupola. Two elevators have been installed to raise the stock to the levels of the two runways. The extra elevator is held in reserve as insurance against a breakdown at a critical time.

Scrap in Charge Estimated

Pig iron and scrap are brought to the platform on trucks as illustrated in Fig. 4. Coke is taken through a runway at a higher level and dropped on the platform. The sides of this runway may be seen to the right in this illustration. To the left in the upper portion of the illustration a man may be seen standing on the coke runway above the pile of coke. A portion of the scrap pile is shown below to the left. The platform in no way interferes with the work of the foundrymen. Its strength may be estimated from the fact that it will hold three carloads of coke and 250 tons of metal. The pig iron is weighed, but the amount of scrap is only estimated. This is possible because none but the home scrap is used and the company finds that no difficulty is experienced from this method of charging the cupola. Each day 32 to 34 tons of metal are melted and the amount of scrap and sprue from one day to the next varies but little. The scrap from one day is placed on the platform ready for charging the following day and the cupola man can estimate from the size of the scrap pile how much to add to each charge. However, as has been said, this amount varies only slightly from day to day. As may be noted in Fig. 4 the original door openings of the cupola were enlarged to facilitate charging and the doors were never put back in place.

Wood is becoming scarce and expensive, so little is used for lighting the cupola. Only enough wood to protect the lining, which is patched after each heat, is stood around the lower side walls of the cupola. This wood serves to keep the falling coke from striking the side walls. The heat for firing the coke is secured from an oil burner placed in one of the tuyeres, as is shown in Fig. 3. Oil is burned on an average of 45 minutes before the coke becomes thoroughly ignited.

Cupola Advantageously Located

Clean iron is secured by tapping the receiving ladle at the bottom, thus getting no slag in the hand ladles.

Located as it is in the center of the molding space which is 200 feet square, the cupola is only 200 feet of the fartherest mold, but the iron does not cool to any marked degree while being carried this distance.

The exacting care which is required in molding piano plates is followed in finishing them. After the castings are made they are taken to the sandblast room to be cleaned. Chipping and grinding are the next operations. These are performed with air chissels and portable grinders actuated by compressed air. Ordinarily these operations finish the work on castings by the foundry

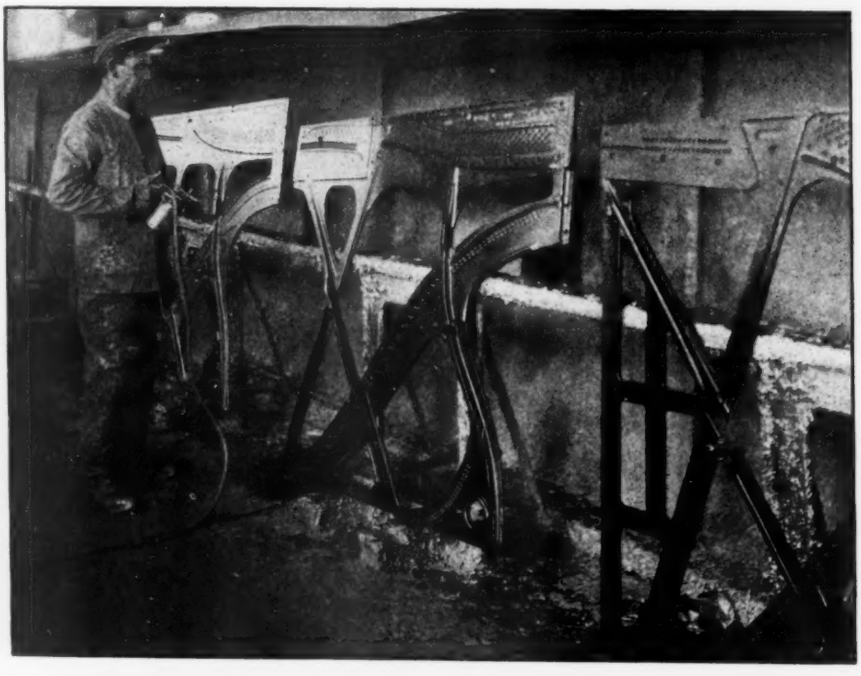


FIG. 6—AFTER PLATES ARE JAPANNED THEY ARE BRONZED WITH AN AIR BRUSH—FUMES ARE CARRIED OFF THROUGH DUCTS AND RECOVERED WHEN PASSED UNDER WATER

organization, but the Superior foundry drills and bronzes the plates before shipment is made.

Drilling is done in a long narrow room fitted with a double row of drills between which is an aisle. A portion of this room is illustrated in Fig. 5. The casting in the foreground gives an idea of the number of holes which must be drilled in each plate. The base bridge pin holes are drilled with a No. 38 drill. The base hitch pin holes are slightly larger requiring a No. 24 drill. These holes are always located by templet for drilling. The tuning-pin holes are considerably larger and sometimes are drilled with the aid of a templet and at other times they are spotted on the casting in the foundry. These holes are drilled with a 27/64-inch drill. Several rows of them may be noted in the plate in the foreground of Fig. 6 which also shows the bronzing operation. Some of the small trucks for skidding the plates around the shop may also be seen in this illustration.

Two methods of cutting the expense of this machine operation have suggested themselves. The one is the use of multiple spindle drills. By their use the entire plate might be drilled in a minute, whereas 40 minutes now are required for this operation. The cost of the multiple drill press, together with the expense entailed in setting it up for every job and of the upkeep have decided the company against its installation. The other method by which the expense of drilling might be lowered is casting in the pins. This method was rejected because it was found that the metal in the pins tends to crystalize when cast in the iron. This is due to the portion of the pin in the iron becoming heated to almost fusion while the portion protruding into the mold remains comparatively cool. Under present practice the pin is hammered into the drilled hole. The head is then flattened and the pin is bent at a slight angle. If the metal were not ductile, but hardened by crystalization, it would break when bent. In addition to being drilled, the plate must be machined to allow the back rib to fit against the wooden pin blocks of the piano, as solidity is most necessary in producing a piano.

Machining is followed by several operations to give the front of the plate the desired finish. First the plate is japanned, then baked at 180 degrees Fahr. until dry, after which it is rubbed down. These operations are repeated in order. Some plates are shipped after the second japanning. Others are bronzed and baked at 1250 degrees Fahr. The letters are then blacked and the whole is coated with a spray of varnish to protect the bronze. The japan, bronze and varnish all are applied with an air spray. The fumes from the sprayer are carried off through ducts leading from the hood behind the casting, as shown in Fig. 6. These ducts lead through a water bath in which the liquids are collected.

Some plates are crated for shipment. Others are placed upright in the cars in rows with wooden cleats between them to prevent them from rubbing against each other. Maple wood is used for the brazing because it is not likely to break.

Oxides in Cast Iron

J. Shaw, Brightside Foundry & Engineering Co., Ltd., Sheffield, England, presented an interesting discussion on oxides in cast iron at a meeting of the Sheffeld branch of the Institution of British Foundrymen, April 16. This discussion grew out of the following question:

"Does the addition of oxygen to cast iron add to the strength of the latter material as put forward by Johnson and suggested again by another American author last year? Also, can oxides exist in a cast iron of say total carbon 3.25 per cent, silicon 1.25 per cent, manganese 0.4 per cent, phosphorus 0.4 per cent, sulphur 0.12 per cent, as affirmed by Professor Porter and Dr. Moldenke?"

In discussing this question, Mr. Shaw said:

On the latter point, Dr. J. E. Stead stated some time ago that he did not think any oxide would exist in an iron containing 2 per cent silicon. I am putting the question forward because of certain experiences covering a good many years and a large number of cases.

At a firm with which I was once connected, having blast furnaces of its own frequently making forge pig iron, it was the custom when the iron was too gray for forge purposes to transfer it to the foundry. Often when this gray forge iron was melted in the cupola the resultant metal in the ladle showed a curious visible phenomena. When the ladle of molten metal was skimmed off, and the usual oxide film covered the surface of the metal due to its contact with the air, there appeared under this film spots which immediately spread out to the size of a quarter of a dollar. There appeared to be some chemical reaction taking place accompanied by heat, because these spots were of a higher temperature than the surrounding metal. If the ladle were allowed to stand for a time, as the temperature of the metal dropped, the spots turned black as they spread out to the size of a quarter. The ladle would contain a large number of these black patches. If the oxide film on the top of the metal were now pushed aside, these black patches could be taken off the top of the metal and would have the appearance and composition of hammer scale. It must be borne in mind that during this reaction, if such it was, the top oxide film was not broken, nor did any flame burn as it usually does. This phenomena was of such common occurrence that all the molders recognized it at once.

Their trouble was that no matter how hot the metal was melted, it lacked life when run into the molds, and short cold-shuts on the top side often showed under the water test. The iron behaved much as Dr. Moldenke states iron held in the air furnace does when trying to reduce silicon in malleable work.

Taking it for granted that oxide inherent in the iron as received from the blast furnace was the cause, I made small additions of finely powdered 80 per cent ferromanganese down the spout of the cupola as the metal was tapped. This stopped the appearance of the spots at once, and the resultant metal was more fluid. The small additions of ferromanganese on analysis had not altered the composition of the metal as far as we could tell.

I may say I have cast hundreds of tons of iron with practically the same composition so far as the ordinary constituents go, without this trouble, when the blast furnace was working on a foundry burden. I would appreciate further discussion of this phenomenon.

Incorporate New Furnace Enterprise

The Ajax Electrothermic Corp. recently was incorporated under the laws of New Jersey to take over from the Pyrolectric Instrument Co., the manufacture and sale of the Ajax-Northrup high frequency induction furnace, together with all patents covering the furnace which formerly were owned by the Ajax Metal Co., Philadelphia. The offices and works will be at 636 East State street, Trenton, N. J.

The new company is controlled by the Ajax Metal Co. which has financed the development of Dr. Northrup's furnace since its inception. The officers chosen were: G. H. Clamer, president; E. F. Northrup, vice president and technical adviser; H. F. Porter, treasurer and works manager; and Dudley Wilcox, secretary and sales manager.

Correction in Address

The Globe Metal Products Corp., which was mentioned in the May 1 issue as having taken over the Globe Co., is located in Sheboygan, Wis. instead of Cheboygan, Mich.

The Monroe Foundry & Furnace Co., Monroe, Mich., is in the market for a hot metal monorail to parallel the foundry gangway.

Reclaiming Metal Parts From Sand

Thorough Screening With Suitable Magnetic Means for Removing Iron Objects From the Foundry Sand Has Resulted in Considerable Saving to Several Large Foundries

BY GEORGE H. MANLOVE

RECENTLY the builder of a new foundry bought three carloads of old foundry sand to use in filling a low spot in the floor. When workmen spread this material, they found chain slings, flask clamps, chillers, nails, air chisels, wrenches and almost every variety of metallic object used in a foundry. The salvage belonged to the buyer, and he is using the tools and has melted the rough iron in his cupola. However, he called upon the seller to view the collection of material found in the sand, and they estimated that its value was sufficient to pay for the sand and its handling.

As a result of this incident, the foundryman who sold the sand has installed a magnetic separator through which all used sand is passed before reuse in the molding mixture or disposal as waste. Metal and usable accessories recovered repay many times the cost of operating the equipment. The new foundry, which profited from the metal found in its filling sand, gained its object lesson early and will have a separator as soon as one can be constructed.

Magnetic attraction, which acts on iron and steel and does not affect sand, bricks, coke and wood, is employed simply to catch the former and pass the latter. An efficient form of separator consists of a revolving screen that takes out all the sand, preparing it for further use, and passes larger material out its lower end onto a belt running slowly toward a large pulley over which the material cascades. This pulley is energized by an electro-magnet, every part of its circumference being magnetic and exerting a strong attraction on all iron or steel passing over it. The coke, bricks, wood and sand lumps fall directly downward into a wheelbarrow or bin; but the iron is held by the magnet until it has passed to the under side of the pulley. The belt gradually draws it away from the pulley face until gravity overcomes the weakening pull of the magnet, and the suspended iron drops into a chute that delivers it at one side.

In some instances, notably where slag containing iron *shot* is to be disposed of, or where large pieces of metal which would damage the screen are likely to be encountered, a crusher is installed as the first unit of the system. This breaks up the slag and releases the *shot*, or calls attention to the large chunk of material, which can be removed before it has opportunity to do any damage. These crushers are of the impact type by preference, as these do not suffer damage from the larger pieces of iron.

Large Systems Employed

Two installations by the Dings Magnetic Separator Co., Milwaukee, are of especial interest from their relatively large size and from the saving they have effected in foundry practice. Both were built for a definite purpose and from the experience gained in taking out the "bugs" that often develop in new devices, it has been possible to standardize construction to a degree that gives efficient operation in similar installations now being prepared for other users.

One of these separators has been in use several years at the plant of the Worthington Pump Co., Cudahy, Wis., formerly the plant of the Power & Mining Machinery Corp. This is shown in an accompanying illustration. It includes a hopper into which the crane grab bucket dumps sand from the shaking-out floor, whence it passes to the revolving screen which removes practically all the sand and breaks up the lumps of sand and cores. The sand falls directly to the floor ready for use in the new sand mixture. Larger pieces pass out of the screen and along a conveyor belt to the magnetized pulley over which nonmagnetic material passes directly, while the iron and steel is carried under the pulley and dropped into a chute which carries it to a tray at one side. This tray is fitted with hooks for the crane slings and the accumulation is carried elsewhere for sorting.

In this foundry the practice is to work over at night all sand left at the close of the day, the shakeout floor being thus cleared in readiness for the next day's work. The clamshell bucket has a capacity of 1½ yards and in practice about 8 yards an hour are brought to the separator, which usually cleans 5 to 10 tons an hour. The hopper is large enough to hold sufficient sand to last ordinarily until the next trip of the crane.

The salvage consists of all the metallic articles that may be lost in a foundry floor, as well as the nails, chills, gagger rods, and metal devices used in the molds. A surprising quantity is reclaimed every week. In this foundry the separator is located close to the sand-mixing machine, and new core sand is prepared by mixing a generous supply of the old sand, which is cleaned by the screen, with the core compound and new sand. Some excess of screened old sand is carried away and dumped.

The magnetic portion of the separator was built by the Dings company, but the screen was adapted from the standard type manufactured as a product of the Worthington plant for mining use.

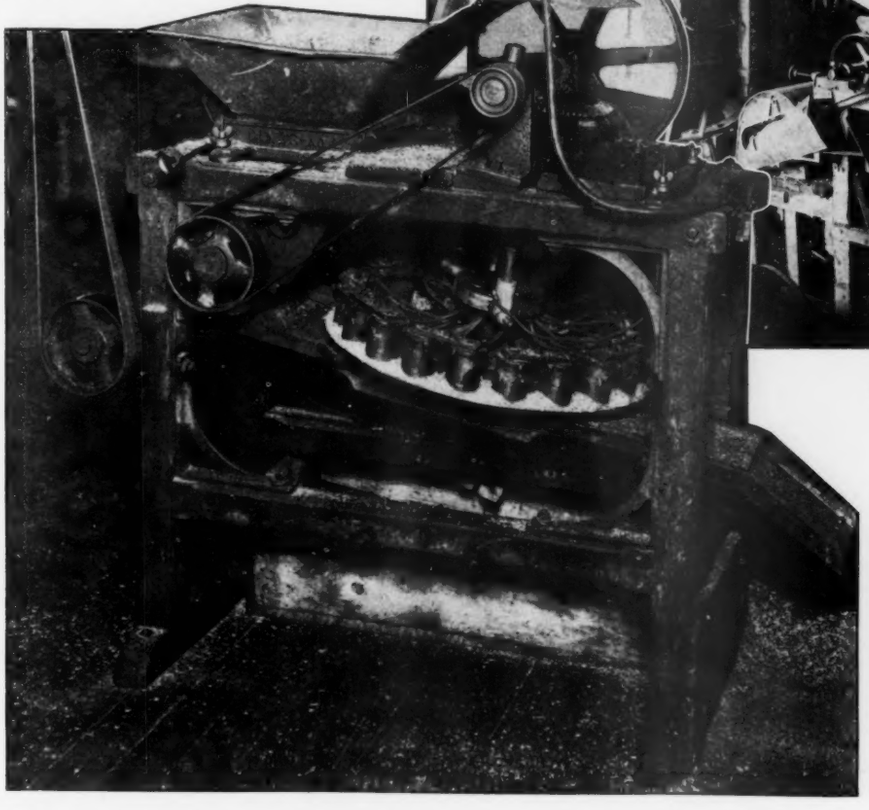
At the plant of the Falk Co., Milwaukee, another large installation is in service. At present this is used in much the same way as the one just described, except that it is mounted on a car with standard-gage trucks and can be moved about the foundry. Shortly this plant is to be removed to one end of the foundry and placed on a foundation, the sand being carried to it by a crane. It then will be arranged to deliver the screened sand into an overhead hopper whence it can be loaded into trucks and carried away to be dumped. The Falk Co. operates a steel foundry and uses comparatively little old sand, having an unusually large quantity for disposal. Space for this waste in the vicinity of the plant has been filled, so that at present two 7-ton trucks remove the waste, taking the sand to some distance.

In this installation the screen was made by the Allis-Chalmers Mfg. Co., and the magnetic equipment by the Dings Co. Recovery is large and the savings pay operating expenses many times over.

An interesting phase of the use of these separators in the Falk foundry

came some years ago when a small portable Dings machine was installed. The floor of the foundry had grown gradually by accretion until it was about 2 feet above grade. It was decided to remove the surplus and mining operations were begun in one corner, all the sand being put through the separator. Nothing of a metallic nature used in a foundry was absent from the collection retrieved by this means. So many nails were found that it gave a surplus sufficient for use over many months. A quantity of the surplus nails was forced on the melter who reluctantly charged them into his furnace, and as a result spoiled his steel through the addition of too much phosphorus and sulphur. Eventually the nails were disposed of in regular practice.

At present, with nails scarce and costing much more than in the past, the salvage of this one item is worth all it costs to clean all the sand, as sufficient new nails are almost unobtainable. The greater part come through sufficiently straight for immediate use, although some must be straightened before they can be used.

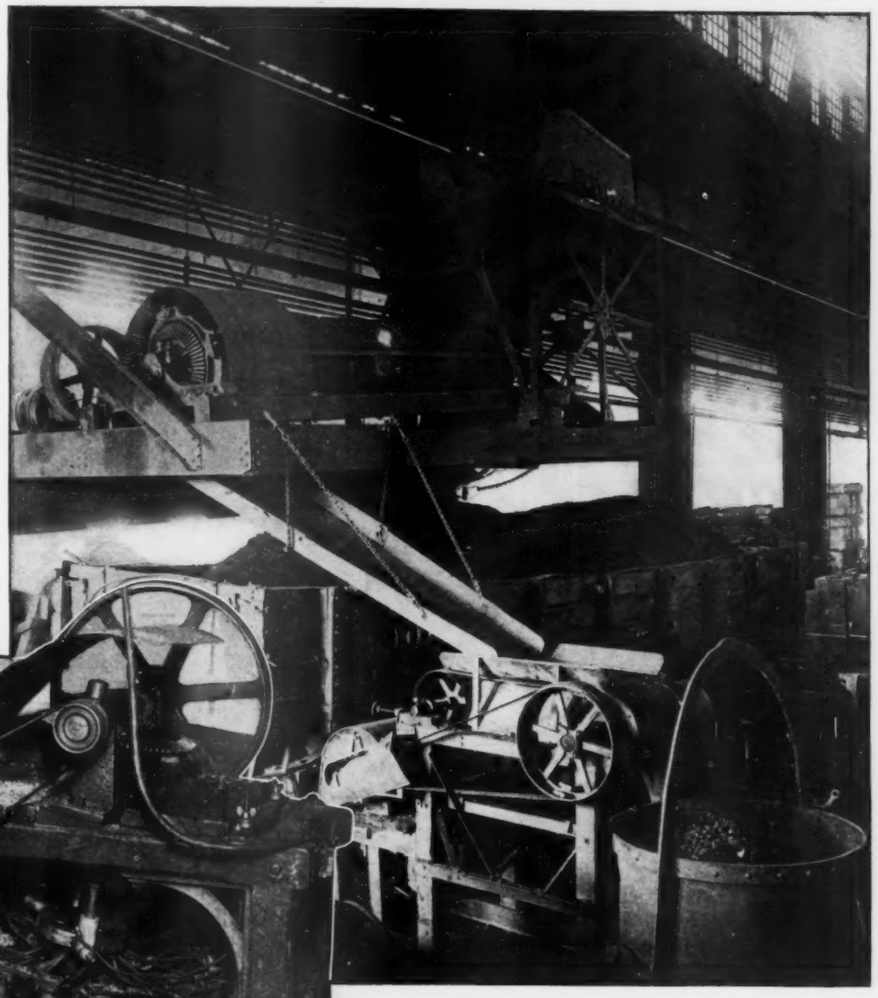


THIS OLD SEPARATOR HAS BEEN IN SERVICE FOR 19 YEARS WITHOUT REPAIRS OR REPLACEMENTS EXCEPT NATURAL WEAR OF BEARINGS—AN OLD TYPE FOR NONFERROUS SCRAP

In the mining operation mentioned, articles as large as match plates were found imbedded in the sand. This is no reflection on the practice in the foundry, but simply one of the constant unpreventable losses met in every foundry where the sand is not all screened and separated.

In some plants the floors are cleaned down to grade from time to time, and the sand riddled by hand. This is a laborious process well-nigh impossible with labor as scarce and costly as it is at present. The screen and magnetic separator reclaim all the losses and can be operated by one man.

The Allis-Chalmers Mfg. Co., Milwaukee, for some years has employed a reclamation system in which the screen unit is mounted at a sufficient height, so that an ordinary railway car may be run underneath to convey reclaimed sand back to the mixing floor. The heavier material is passed over a separator and the refuse is caught directly in a large bucket which may be picked up by the crane and removed.



SAND RIDDLE AND RECLAMATION SYSTEM IN USE AT A HEAVY WORK SHOP—NOTE THE MODE OF RETURNING THE SCREENED SAND

A variation of the impact pulverizer to break up lumps before passing the sand into the screen requires a ball mill, of a type used in mining practice, which has given excellent results in some of the larger installations.

Another type of magnetic separator, differing only in design, consists of a revolving cylinder, placed at a slight incline, through which the material is passed. Sand passes through the screen, larger particles advancing to a further section of solid material. On one side of this section a semicircular electro-magnet

is placed immediately outside the cylinder, spanning it from the bottom to the top on one side. Metallic objects adhere by magnetism to the side of the revolving cylinder and are carried to the top and there released as they pass beyond the edge of the magnetized field. A chute in the axis of the cylinder catches them as they fall and conveys them to a receptacle apart from the sand and rubbish, thus dividing the material into three classes.

Other Uses Possible

Other uses for the magnetic separator are found in a protective way, such as the removal of "tramp" iron from coal being fed to a pulverizer, pickpoints, hammerheads, railroad spikes and bolts, which often do great damage to machinery. In the manufacture of glass it is used to remove steel and iron particles from raw materials before they are melted.

The heart of the magnetic separator is in the magnetized pulley, which is made of dynamo steel. The interior is filled closely with metal and insulation to give requisite strength of magnetic current. In action, the belt passing over the pulley carries away such heat as is generated by the electric current and the magnet runs cool at all times. The pulley is energized without the use of a commutator, doing away with sparks and flashes. No brush or scraper is needed to remove the attracted iron, as it falls as soon as the return belt leaves the face of the pulley. The only wearing parts are the shaft bearings and contact rings.

An interesting sidelight on the magnetic separator is found in the fact that J. J. Ryan & Co., Chicago, brass founders and finishers, have had an early type of magnetic separator manufactured by the Dings Co. in service for the past 19 years, without repairs or replacements except such as have arisen from the natural wear of bearings. It handles an average of 4 tons a day of brass turnings and grindings, removing all iron cleanly. It is in operation practically all the time.

The Ypsilanti Hay Press Co., Ypsilantic, Mich., has sold its plant to the Ypsilanti Foundry Co., which is an organization made up of the owners of the Central Specialty Co., a foundry concern, of Detroit. Piston rings will be the principal product in connection with light automobile castings. The present shop will be enlarged. J. H. Lonskey, manager.

Organize Safety Museum

A safety museum to rank with those operated in Milan, Paris, Berlin and several British manufacturing centers, now is being organized in Jersey City, N. J. It is to be the first state clearing house of industrial standardization ever attempted in this country and it is intended to cover every phase of the wastes of productive industry. The executive committee is to be composed of representatives of chamber of commerce, insurance carriers and labor, with two advisory boards, one consisting of the chiefs of the bureaus of the New Jersey state department of labor and the board of health, and the other of representatives of all New Jersey industries employing more than 2500 employes. The many subdivisions of the museum will be operated under a competent engineering and personal staff. It is proposed to establish safety locals in each manufacturing center of the state. Practical engineers will give weekly talks at the museum in Jersey City, as well as at various headquarters of the safety locals, on subjects appealing to the interests of plant managers, superintendents and foremen. The federal board for vocational education already has placed several ex-service men from the division of rehabilitation under R. J. Woodhouse, consulting engineer of the museum, for training as engineers.

Open Detroit Office

Charles L. Kerr and A. L. Grinnell, representing the American Fire Clay & Products Co., Cleveland; the Quigley Furnace Specialties Co., New York, and the Columbian Facings Mills Co., Buffalo, were erroneously reported as having opened an office at 505 Garrick building, Chicago, in the May 1 issue of THE FOUNDRY. The address should have been Detroit instead of Chicago.

Acquires Plant Facilities in New Jersey

The Carborundum Co., Niagara Falls, N. Y., recently has acquired from the alien property custodian, the plant formerly owned and operated by the Didier-March Co., at Perth Amboy, N. Y. This plant has been taken over and will be converted to the manufacture of the purchasing company's refractories. The principal business of the Didier-March Co. was the manufacture of special refractory clay products and its equipment is well adapted to the uses of the new owner. It consists of a modern clay working and refractory plant with a capacity of over 100 tons per day, office buildings and laboratories together with housing facilities for employes. The Carborundum Co. also has acquired about 60 acres of high grade fire-clay land at Bonhampton, with a clay excavating plant ready for operation.

In addition to the regular line of made-up refractories, the new plant at Perth Amboy will produce a complete line of high grade refractory cements. At the present time 10 special grades of cement are produced and sold by the Carborundum Co., as it has not been found possible to produce a refractory cement which will cover all required conditions.

Germans Advance Casting Contract Prices

The German Association of Ironfoundries, reporting on the first quarter of the present year, states that the scarcity of raw materials and the further advance in prices were more perceptible, and rendered it difficult to execute orders which continued to arrive in large numbers. It was also impossible fully to occupy the workmen on account of the reduction in the supply of pig iron and coke. It was necessary to raise the prices of castings owing to the general increase in the costs of production. The demand for merchant castings continued large, so that it would no longer be possible to execute some of the new orders in the current year. In general, the sale prices paid were those fixed by the district groups of the association. A continuing large demand for machine castings was reported from North Germany, and activity was also good in central Germany. The prices of cast pipes also advanced in accordance with the higher costs of production, but only the most pressing requirements are being ordered on account of the high prices.

Presents Paper On Coke

At the May meeting of the New England Foundrymen's association, E. H. Bauer, engineer of manufacture, Providence Gas Co., Providence, R. I., presented a paper on the manufacture of coke and its uses in general foundry practice. The meeting was exceptionally well attended and marks the close of the present season of Boston meetings of the association. On the second Wednesday of June, the New England Foundrymen's association will be the guests of the Connecticut Foundrymen's association at Hartford

Manufacturing Chilled Iron Car Wheels - V

Inspection and Tests Assure Adherence to Standard Specifications

BY H. E. DILLER

RESPONSIBILITY of the manufacturer does not cease when car wheels are completed, pitted and ready for delivery. In most cases a rigid inspection is provided to assure the quality and soundness of the product. Each railroad company has its own specifications based upon those of the Master Car Builders' association. These specifications are presented in an accompanying table.

The first item covered concerns the quality of the material and the chill. As previously was noted, chaplets are cast into the wheel, and some types of chaplets which are used without protection against the action of the molten metal, fuse into the surface of the wheel. These, in general, are heavy and impart a chilling effect to the iron of the wheel. Therefore, danger of too great a chill from chaplets is an item of consideration in the specifications.

Possibly the most important part of the wheel is the tread and flange, and it is essential to have the correct depth of chill at these places. If the chill is too deep it is an indication that the metal in the wheel is harder than necessary and more likely to crack and break under service conditions; but on the other hand if the chill is too thin the life of the wheel is shortened. At the place where the white iron merges into gray iron forming the body of the wheel, there is a section which is neither white nor gray. This division is difficult to locate but with a little experience the inspector soon learns to decide the correct point for gaging the depth of the chill and few disputes ever arise over this question. It is the universal custom of inspectors to favor the low side when determining the depth

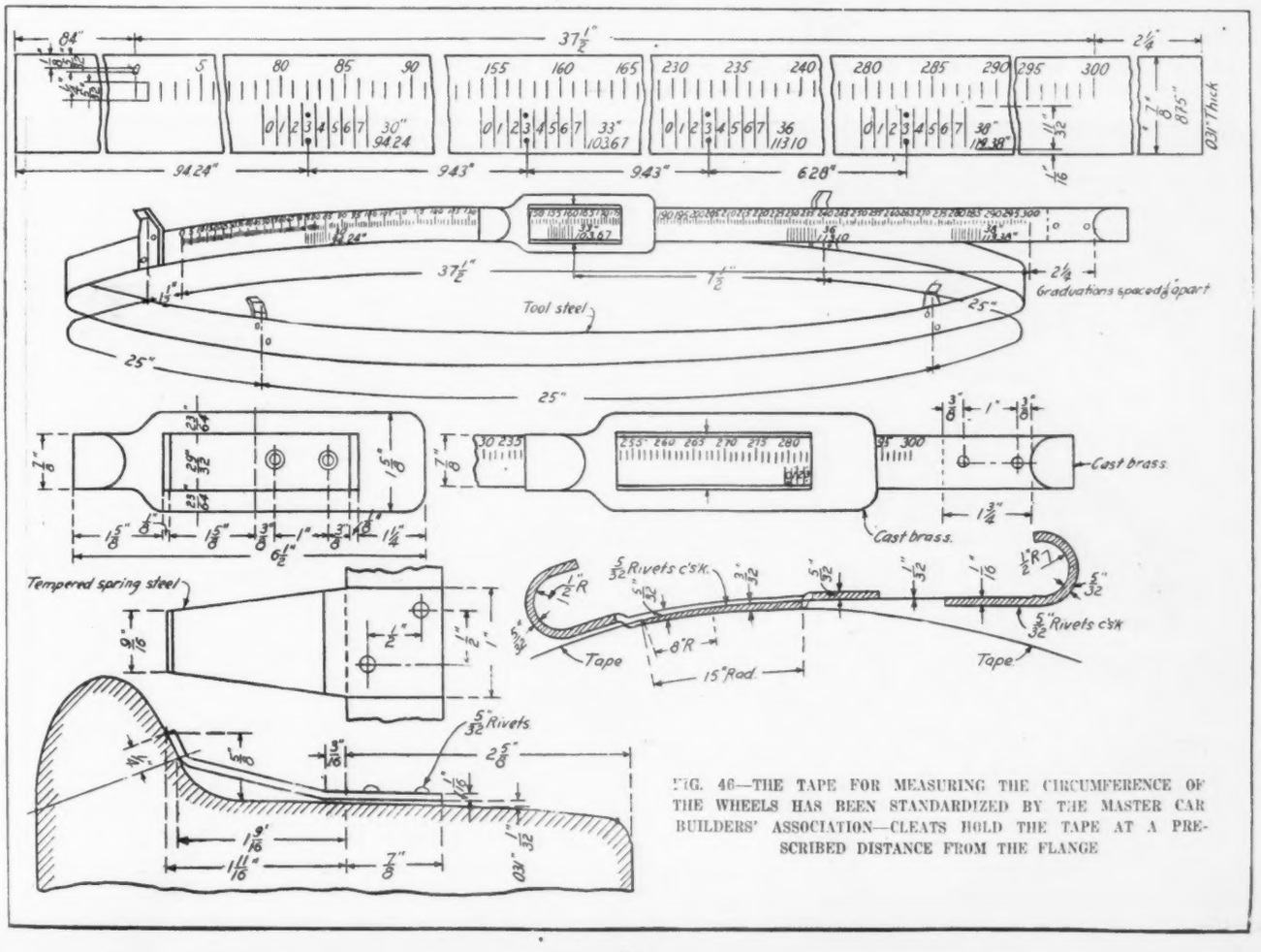


FIG. 46—THE TAPE FOR MEASURING THE CIRCUMFERENCE OF THE WHEELS HAS BEEN STANDARDIZED BY THE MASTER CAR BUILDERS' ASSOCIATION—CLEATS HOLD THE TAPE AT A PRESCRIBED DISTANCE FROM THE FLANGE

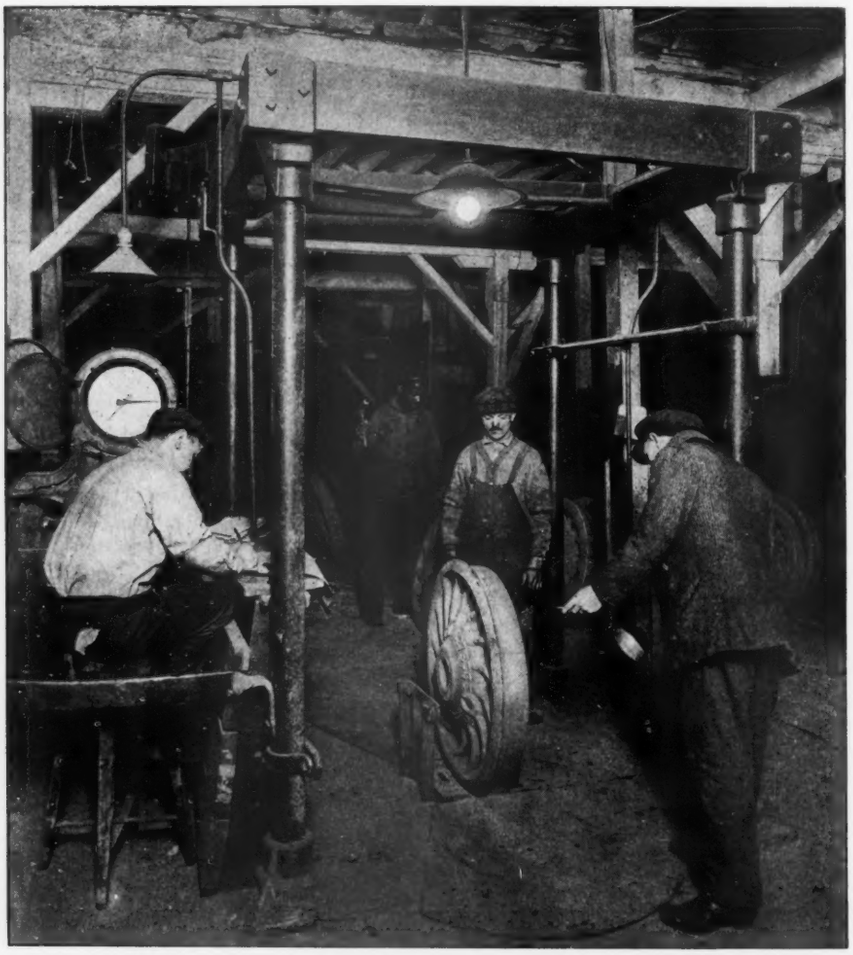


FIG. 47—A RECORD IS KEPT OF THE WEIGHT OF EVERY WHEEL—AT THE TIME THE WHEEL IS WEIGHED AN INSPECTOR MEASURES THE FLANGE WITH A GAGE

of chill. That is, if there is a question of the chill being too deep, the wheel is rejected, but if there is a doubt as to whether the depth of chill is too thin the wheel is passed. In the first place, too deep a chill might cause a wheel to break and thus imperil the safety of traffic, while a chill which is too thin would only result in a shorter wheel life. Furthermore, the wheel has a guaranteed life so that the railroad will be compensated should it wear out before the allotted time. This guarantee usually covers a length of service of six years for freight cars and two years for passenger cars and locomotive tenders.

Rejecting Wheels

Wheels are inspected in lots of 100. Before passing the wheels to the customer's inspector many of the foundries give them a close manufacturer's inspection for surface defects. They are careful to see that no defective wheel is among those given to the customer's inspector, as the failure of one wheel in the drop test or in the thermal test throws out a number of other wheels. Such inspection by the manufacturer materially reduces the number of rejected wheels.

The drop test is made on one out of each lot of 100 wheels. This test is made by dropping a 200-pound tup on the wheel which is placed horizontally on three supports with the flange down, so that the tup will strike centrally on

FIG. 48—THE THERMAL TEST IS MADE BY POURING MOLTEN METAL INTO A CHANNEL FORMED WITH SAND AROUND THE WHEEL—IF THE WHEEL IS CRACKED FROM THE PLATE THROUGH THE RIM THE LOT IT REPRESENTS IS REJECTED

the hub. The wheels must withstand a certain number of blows from the tup dropped from a designated height. This requirement is given in Table 1 of the specification. It is essential that the foundation and weight of the anvil on which the wheels are placed should be specified, for the resistance to a blow is greatly modified by any resistance in the support. Should a wheel be placed on a heavier anvil more rigidly supported it could not stand nearly as many blows of the tup. On the other hand, were the anvil sufficiently light and the foundation pliable enough, it would be possible for practically any wheel to withstand the test. For this reason, the specifications require that the anvil shall weigh not less than 1700 pounds and shall be supported on rubble masonry at least 2 feet deep.

Drop-test Machine

A typical drop testing machine is illustrated in Fig. 52. The wheel with the belt revolves continually and turns the sheave, located to the right of it. To raise the tup, the operator pulls on the rope which is wound around the sheave. After the tup has been raised to the required height it is automatically tripped and falls upon the wheel. The catch then is allowed to slide down the guides and again engages the tup. A steel form covered with a wire screen is placed over the wheel to prevent flying sparks from striking the operator. This protective covering is carried on a guide and is raised to allow the wheel to be taken out or placed in position. When raised the pawl *B* engages a notch on both sides of the guide. One of these notches is shown at *A*. After the number of drops required by the test have been made the tup is raised to a sufficient height to break the wheel when it is dropped. The wheel is broken to enable the inspector to examine the metal in the hub and plates and to measure the thickness of the front and back plates. The destruction of the specimen also prevents a wheel which has been subjected to the severe shock of the drop test from accidentally being placed in stock and put into service.

FIG. 50—THE BRAKING EFFECT ON WHEELS HAS BEEN THOROUGHLY STUDIED

When under the cars, wheels are subjected to severe treatment by application of the brakes. The brake shoes are made of a hard grade of cast iron, sometimes with inserts of manganese or other hardened alloy steel. These grip the wheel with such force that on long grades the shoes become heated to a dull red, and for this reason, the wheel must be able to withstand severe thermal action. A test for this qualification has been devised and has been in operation with little modification almost since wheels first were tested.

Wheel Withstands Heat

The details of this test are outlined in the M. C. B. specifications. The wheel is laid with the flange downward in sand and a 1½ x 4-inch channel is molded around it. Molten iron of a specified degree of heat is then poured into the channel around the wheel and against the flange and tread of the wheel. This procedure is illustrated in Fig. 48. A brick propped by a steel bar is placed on the rim of the wheel at the point at which the metal is poured. This acts as a shield to prevent metal from splashing over the surface of the wheel. Should the wheel be broken by this test, or should cracks be found in the plate extending through or into the rim, all wheels of the lot

FIG. 49—STANDARD FORMS ARE KEPT TO CALIBRATE THE TAPES—ONE OF THESE IS SHOWN TO THE RIGHT—THE POSE OF THE MAN TAPING THE WHEEL IS CHARACTERISTIC

Master Car Builders' Association Specifications for Cast-iron Wheels

33-inch—for Cars of Maximum Gross Weights, Not to Exceed 95,000 Pounds, 132,000 Pounds, 161,000 Pounds and 210,000 Pounds

RECOMMENDED PRACTICE

ADOPTED 1893. *Revised* 1899 *and* 1904. *Modified* 1911 *in reference to cast date. In* 1912 *measuring line for nominal diameter was designated as A. B. and the diameters of cores added to drawings. Revised as to form in* 1913. *In* 1914 *the thermal-test clause (b) was corrected. In* 1914 *section* 14, *"Marking Wheel," was corrected. In* 1915 *section IV, paragraph* 7, *was modified to include* 850-*pound wheel in* 1917.

1 MATERIAL—The wheels shall show clean, gray iron in the plates, except at chaplets, where mottling to not more than ½ in. from same will be permitted.

2 CHILL—(a) The depth of pure white iron shall not exceed 1 inch nor be less than ½ inch in the middle of the tread.

(b) It shall not exceed 1 inch in the middle of the tread nor be less than ⅜ inch in throat for wheels having a maximum weight of 625 pounds.

(c) It shall not exceed 1 inch in the middle of the tread nor be less than 7/16 inch in the throat for wheels having a maximum weight of 700 pounds.

(d) It shall not exceed 1 inch in the tread nor be less than ½ inch in the throat for wheels having a maximum weight of 725 pounds and 850 pounds.

(e) The depth of white iron shall not vary more than ¼ inch around the tread on the rail line in the same wheel.

II PHYSICAL PROPERTIES AND TESTS

3 SAMPLING—When ready for inspection, the wheels shall be arranged in groups, all wheels of the same date being grouped together, and for each 100 wheels which pass inspection and are ready for shipment, two representative wheels shall be taken at random, one of which will be subject to the drop test.

4 DROP TEST—The wheels shall conform to the following drop test requirements:

(a) The test wheel shall be so placed on the three supports, with flange turned downward, that the tup will strike centrally on the hub. When tested in accordance with the following conditions, the wheel shall stand the following specific number of blows:

TABLE I

Weight of Wheel Pounds	Weight of Tup Pounds	Height of Drop Feet	Number of Blows
625	200	9	10
700	200	10	12
725	200	12	12
850	200	15	12

5 THERMAL TEST—Should the test wheel stand the given number of blows without breaking into two or more pieces, the inspector will then subject the other wheel to the following test:

(a) Preparation—The wheel shall be laid with the flange downward in the sand and a channel way 1½ inches wide and 4 inches deep must be molded with green sand around the wheel. The clean tread of the wheel must form one side of the channel way and the clean flanges must form as much of the bottom as its width will cover.

(b) Test—The above described channel must be filled with molten cast iron, which shall be hot enough, when poured, so that the ring which is formed, when the metal is cold, shall be solid or free from wrinkles or layers. The time when pouring ceases must be noted, and two minutes later an examination of the wheel must be made. If the wheel is found broken in pieces or if any cracks in the plate extend through or into the rim, all wheels of the same tape size as the wheel broken will be rejected.

6 DROP-TEST MACHINE—The three supports shall not be more than 5 inches wide. The anvil shall be supported on rubble masonry at least two feet deep and shall weigh not less than 1700 pounds. The striking face of the tup shall be 8 inches in diameter and be flat.

III RETEST

7 NUMBER OF TESTS—In making the drop test, should the test wheel break into two or more pieces with less than the required number of blows, then the second wheel shall be taken from the same lot and similarly tested. If the second wheel stands the test it shall be optional with the inspector whether he shall test the third wheel or not. If he does not do so, or if he does and the third wheel stands the test, the 100 wheels will be accepted as filling the requirements of the drop test.

IV DIMENSIONS, TAPING AND GAGING

8 DIMENSIONS—The normal diameter of the wheel produced by the chill must be the M. C. B. standard 33-inch, measured at a point 2⅝ inches from the outside of the tread of the wheel. Wheels furnished under this specification shall not vary more than 1/16 inch above or below the normal size measured on the circumference and the same wheel shall not vary more than 1/16 inch in diameter.

The thickness of the flange shall be regulated by the maximum and minimum flange thickness gages adopted by the Master Car Builders' association.

9 TAPING—All wheels shall be taped with M. C. B. standard design of wheel circumference tape, having numbers 1, 2, 3, 4 and 5 stamped ⅛ inch apart, the figure 3 to represent the normal diameter 103.67 inches circumference. The figure 1, the smallest, and the figures 5 the largest.

V WEIGHTS

10 (a) All wheels furnished under these specifications shall conform to the respective sections shown by the M. C. B. drawings for different weights of wheels, and weights shall be as follows:

Maximum Gross Weight of Car Pounds	Maximum Weight of Wheel Not Exceeding Pounds	Maximum Weight of Wheel Not Less Than Pounds
95,000	625	615
132,000	700	690
161,000	725	715
210,000	850	835

(b) Cores—In case of wheels ordered with cores smaller in diameter than the standard, the additional weight should be considered as an addition to the normal weight and paid for by the purchaser.

(c) Note—Weights given in the above table are based on M. C. B. Standard drawings covering wheel design, adopted in 1909.

11 UNDER WEIGHT—Wheels that are under minimum weights will be set aside and not further considered.

12 OVERWEIGHT—Wheels that are over the maximum weights will be at the expense of the manufacturer.

VI WORKMANSHIP AND FINISH

15 MARKING—All wheels shall be numbered consecutively in accordance with the instructions from the railroad company purchasing them, and shall have the initials of such railroad company, also the wheel number, the weight of the wheel and month, day and year when made, plainly formed on the inside plate of casting. No two wheels shall have the same number. All wheels shall also have the name and place of manufacture plainly formed on the outside plate in casting. Wheels conforming to the requirements and furnished under this specification shall have plainly formed on the outside plate, M. C. B. 1909 for wheels of nominal weight of 625 and 725 pounds, and M. C. B. 1917 wheels having a nominal weight of 700 and 850 pounds.

VIII REJECTION LIMITS

16 REJECTION—(a) If in any lot of wheels submitted for test the test wheel fails to meet the requirements of the drop, chill or thermal test, then all of the wheels in tape number and weight corresponding to the test wheel will be rejected.

(b) High Chill—In case the rejection is for high chill, weak breaking strength or failure in the thermal test, the test will be continued in the next higher number of tape size.

(c) Low Chill—If the rejection is for chill, the test will be continued in the next lower number of tape size.

the same tape size as the broken specimen are rejected. Provision is made in the specifications for a check test to be given if a wheel fails under the drop test, but no check test is allowed when a wheel fails under the thermal test.

The diameter of the wheel is governed by the diameter and kind of chiller and by the grade or hardness of the metal. To guard against too soft or too hard metal, the circumference of the wheel must come within certain limits or it will not be accepted. A standard tape, details of which are given in Fig. 46, has been adopted. The tape is made of tool steel and arms or guides are provided to set the tape at the correct distance from the flange. This is necessary because the diameter of the tread increases from the rim to the flange. A buckle with a long rectangular slot is connected to one end and fits over the tape. This may be noted in the tape toward the top of the figure. For each size of wheel, the tape is marked with lines ⅛-inch apart and numbered 0, 1, 2, 3, 4, 5, 6 and 7. At the center of the space marked 3 are two dots. These indicate the standard size of the wheel.

Taping is done by the manufacturer who marks the tape size on the wheel with white lead—that is, the number which comes opposite to the arrows on the buckle when the tape is brought tightly around the wheel. This number is marked so that the railroad inspector can check the measurements of the manufacturer's inspector, which he does on a number of wheels each day. It also serves to enable the assembling

shop to place two wheels of the same diameter on an axle. Fig. 49 shows a manufacturer's inspector measuring a wheel. The buckle is near his left hand, and with the other hand he is stretching the tape. The hook on the end enables him to secure a firm hold on the tape. The bank of graduated rings or disks at the right of the illustration is a standard gage for calibrating the tapes of different sizes. Two tapes are shown and it may be noticed that the upper tape does not have any bracket, because it is used for measuring the circumference of street car wheels which do not have a tapered tread as do wheels for freight cars. Wheels are accepted for standard service when their tape number is from 1 to 5, 3 being the desired number. However, wheels with tape numbers 0, 6 or 7 are accepted for use in service where the requirements are less severe, such as on industrial systems or on smaller roads where the traffic is not heavy.

Weight is Limited

The wheel specifications, it will be noted, include maximum and minimum weights. A table of these limits is given in the specifications in the accompanying table. It is the general custom to pay for wheels by weight but when they are over the maximum allowed by the specifications no extra price is paid, the excess weight constituting a loss to the manufacturer. Wheels under weight are accepted or rejected according to the kind of agreement which is made with the customer.

Every wheel carries marks which thoroughly identify it. On the front of the wheel the manufacturer's name is cast. The legend *M. C. B.* 1909 is cast on for wheels of nominal weight of 625 and 725 pounds, and *M. C. B.* 1917 is cast on for wheels of a nominal weight of 700 and 850 pounds. The numbers indicate the year in which the design was adopted as recommended practice by the Master Car Builders' association. The initials of the railroad purchasing them, the nominal weight of the wheel, the date including the month, day and year the wheel was cast and the wheel number all are cast on the back of the wheel. This number is furnished by the railroad ordering the wheel. The same number is not given to more than one wheel, so if a wheel is

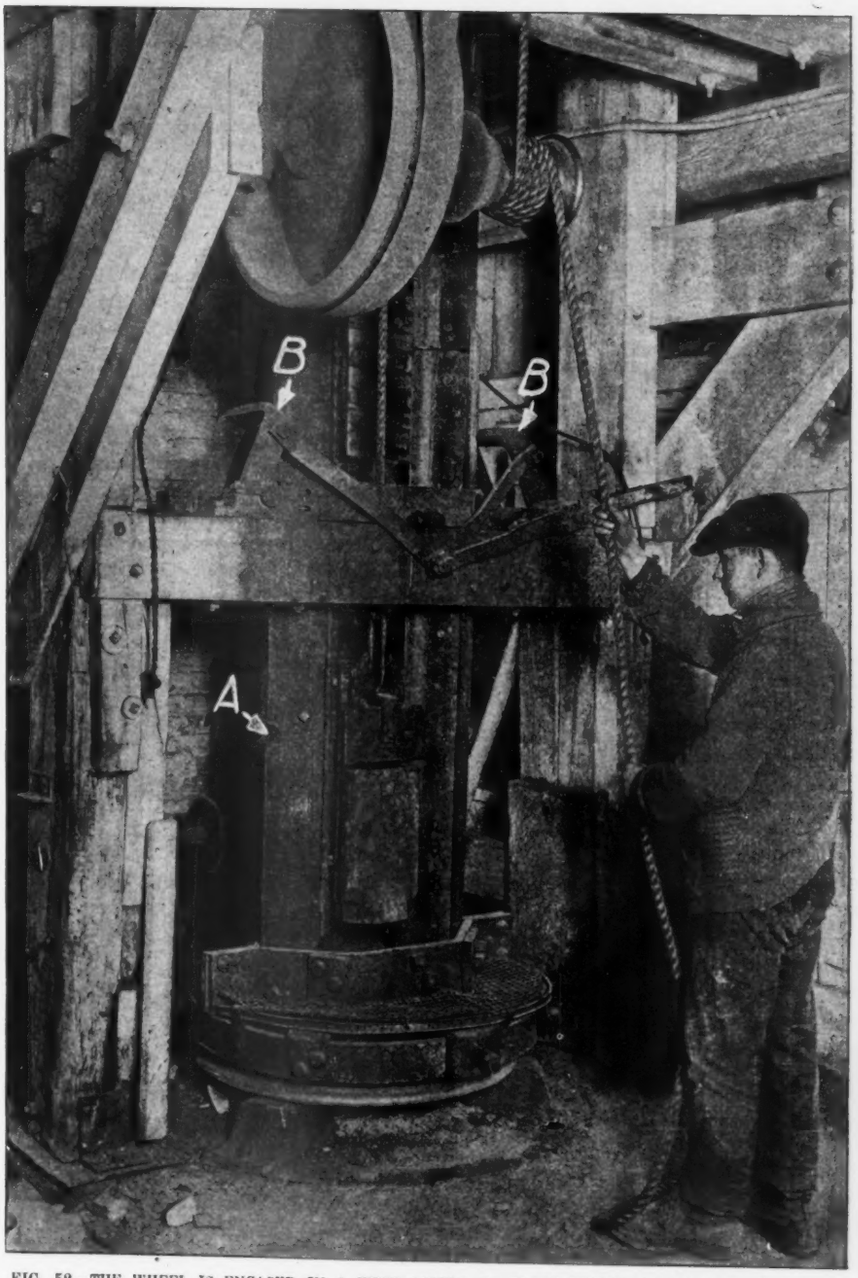


FIG. 52—THE WHEEL IS ENCASED IN A WIRE SHIELD TO CATCH FLYING FRAGMENTS WHEN IT IS BROKEN ON THE DROP TEST

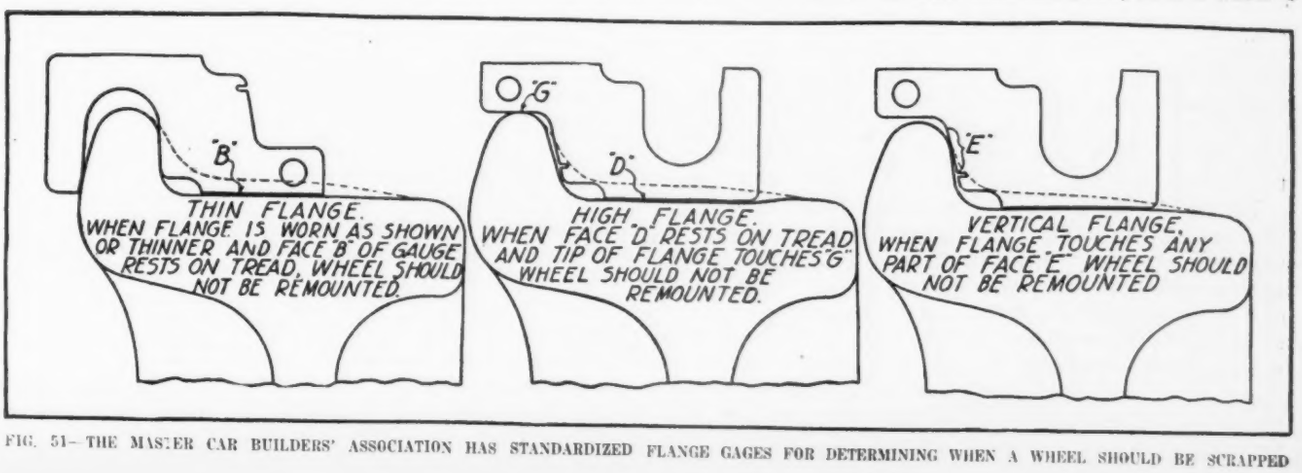

"B"
THIN FLANGE.
WHEN FLANGE IS WORN AS SHOWN OR THINNER AND FACE "B" OF GAUGE RESTS ON TREAD, WHEEL SHOULD NOT BE REMOUNTED.
"G"
"D"
HIGH FLANGE.
WHEN FACE "D" RESTS ON TREAD AND TIP OF FLANGE TOUCHES "G" WHEEL SHOULD NOT BE REMOUNTED.
"E"
VERTICAL FLANGE.
WHEN FLANGE TOUCHES ANY PART OF FACE "E" WHEEL SHOULD NOT BE REMOUNTED

FIG. 51—THE MASTER CAR BUILDERS' ASSOCIATION HAS STANDARDIZED FLANGE GAGES FOR DETERMINING WHEN A WHEEL SHOULD BE SCRAPPED

rejected the purchaser has the record and it cannot later be submitted with another batch of wheels for test. Specific instructions as to the rejection limits are given in the last section of the specifications.

Car wheels are mounted on their axles by pressure, usually through the action of hydraulic presses. The following table gives the minimum and maximum mounting pressures in tons for wheel seats of different diameters:

Wheel Seat Diameter	Minimum	Maximum
5⅛ in.	30	45
5¾ in.	35	50
6½ in.	40	60
7 in.	45	65
7⅝ in.	50	70

After a wheel is accepted by the railroad and put into service it is carefully watched to see that no cracks develop in the flange tread, plate or hub. The wheels also are inspected for other defects in the flange and tread, such as brake burns, brake slides, etc. Loose axles also are watched for carefully. At every terminal and interchange point an inspector looks at all freight car wheels and at interchange points the wheels are examined by the inspector of the road delivering the car as well as by the representative of the road receiving it. When a car is sent to the repair shop, the wheels are given a more thorough inspection and the tread and flange are tried by gages made according to M. C. B. recommended practice. These gages are illustrated in Fig. 51.

The gage at the left is used to detect thin flanges, the middle one indicates high flanges, and the one at the right tells whether the flange has worn to such a degree that the flange forms a sharp angle with the tread, or in other words, is too nearly vertical. The different limits have been determined by experience and by calculating the way the wheel will ride the rail. A flange worn thin, endangers the wheel and increases the chances of dangerous breakage.

Checking the Weight

Before a wheel is submitted to the railroad inspector it is weighed by the manufacturer and the weight recorded. The customer's inspector then checks a certain percentage of the wheels for weight to satisfy himself that the given weights are correct. Accurate automatic scales without springs are in general use for weighing wheels and these are calibrated frequently.

The weighing operation is shown in Fig. 47. The workman at the rear has rolled a wheel on the scales where a plate holds it in an upright position. The inspector is shown in the foreground examining the wheel for surface defects. He also gages the thickness of the flange with the gage he holds in his hand. The checker, at the left, records the wheel number, date and weight of wheel together with the location where it is to be placed on the stock platform.

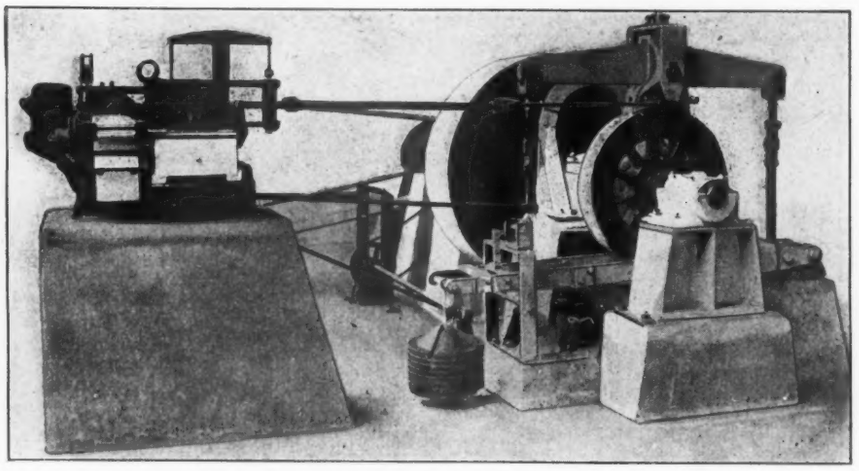


FIG. 53—ELABORATE BRAKING TESTS ARE MADE AT THE UNIVERSITY OF ILLINOIS ON THIS MACHINE

The effect of the brakes upon the wheels is quite marked and much research work has been done to obtain data regarding the action of wheels under different braking conditions. Some of this work was carried out at the University of Illinois, Urbana, Ill., and at Purdue University, Lafayette, Ind. Fig. 53 shows the testing machine used at the University of Illinois. The effect of excessive heating caused by friction between the brake shoe and the wheel, is shown in Fig. 50. The defect in the wheel to the left was caused by excessive brake friction extending entirely around the circumference of the wheel. The brake shoe had a bearing near the rim as is indicated by the scored surface. The same cause produced the abrasions in the center wheel, but here the brake bearing was nearer the throat of the wheel. The marks in the wheel to the right were caused by skidding, which produced short flat spots and heated the metal so intensely that thermal cracks appeared, when through subsequent pounding the metal was disintegrated. Flat wheels which are so noticeable by reason of the noise they make when the car is traveling, are caused by the brakes locking the wheel which slides along the rail and is worn flat at the spot which bears on the rail. Such wheels are reground by some railroads, while others regard the practice of regrinding flat wheels as uneconomical. Several objections are offered. It is said that grinding softens the skin of the car wheel immediately under the grinding wheel. It is also claimed that excessive heating is frequently caused by the grinding and as the grinding wheel passes the heated spot, the hot metal is chilled by the body of metal back of it, thus producing local strains which tend to cause the wheel to crack. It is doubtful on a straight commercial basis whether the saving to be gained is enough to pay expense of grinding.

What has so far been said in this series applies mainly to the manufacture of the standard size chilled iron car wheels. In many respects the practice followed in the manufacture of smaller chilled iron wheels is similar to that used in producing the standard wheel, but there are some essential differences. The smaller chilled iron car wheels, including the mine car wheel, will be dealt with in the next article.

Builds Employes Homes

To assist in relieving the present acute shortage of houses in the Pittsburgh district, the Union Steel Casting Co., has contracted for ten houses to be built at Aspinwall, Pa. These houses will be ready for occupancy by October 1st, and are primarily intended for sale to the employes of the company, being within 15 minutes by street car to the company's plant located at Sixty-second and Butler streets. Originally, it was the intention to build houses within the city limits, but after receiving bids it was found that building outside the city, where building restrictions are not so stringent and severe, could be done at much lower cost.

Additional electric welding equipment will be purchased by the Peck Iron & Steel Works, Kalamazoo, Mich., manufacturer of foundry equipment, which recently increased its capital stock from $30,000 to $60,000. It has purchased an adequate plant at Vicksburg, Mich., at the junction of the Grand Trunk and G. R. & I. railways.

Proper Metal For Piston Ring Pots

Rings are Affected by the Manner in Which the Pots are Cast—Combined Carbon is Higher When Castings are Made in Sand Than When Poured in Chill Molds

METALLURGY of piston rings was treated at length in a paper presented at a recent meeting of the Birmingham branch of the Institution of British Foundrymen by A. Harley, president of the Coventry branch. The subject was looked at from the standpoint of pot castings. Mr. Harley states that there are three principal methods of making piston ring pots, namely; castings in sand molds, in stationary chills and in rotary chills. However, no matter which method is employed, the author believes it is essential to have chemical control of all raw material used in the process. The cupola is said to be a satisfactory melting medium, and the temperature of the metal when cast must not vary from time to time. The following specifications for both sand-cast and chill-cast piston rings are given:

	Sand	Chill
Total Carbon	3.6 Max.	3.9 Max.
Combined Carbon	0.55–0.80	0.45–0.80
Silicon	1.8 Max	1.8–2.5
Sulphur	0.14 Max.	0.14 Max.
Phosphorus	1.0 Max.	1.2 Max.
Manganese	0.6–1.2	0.4–1.2

Tensile by load applied on ring, 31,360 lbs. per square in. min.

Typical analyses of pots cast in sand from cupola metal are given as follows:

Total Carbon	3.43	3.20
Combined Carbon	.53	.63
Graphitic Carbon	2.90	2.57
Silicon	1.44	1.49
Sulphur	.12	.09
Phosphorus	.75	.80
Manganese	1.17	1.09

Tensile tests were made on 13 bars from this metal. The lowest test showed a strength of 29,030 pounds per square inch, while the highest test was 36,600 pounds per square inch. Experience indicated that pots cast in sand from metal of this composition did not always produce satisfactory rings for aeroplane engines. Examined under the microscope the metal showed a rather coarse structure.

Experiments were made to see what results could be obtained by using steel in the mixture. The metal was melted in a cupola, which accounts for the increase in the percentage of carbon from the amount originally in the mixture. The physical tests were made on the finished rings. The extension and permanent set were taken at a stress of 22,400 pounds per square inch. The following are the results of the tests:

Calculated Analysis

T. C.	C. C.	G. C.	Si.	S.	P.	Mn.
1.94	..	..	1.70	.09	.67	.85

Actual Analysis

3.42	.59	2.83	1.60	.13	.63	.85

Average of 33 Tests

Diameter of ring	3.715 in.
Width of ring	1972 in.
Radial thickness	.143 in.
Extension at 22,400 lbs. per sq. in.	.174 in.
Permanent set	.023 in.
Total extension	.449 in.
Breaking load in lbs. per sq. in.	40,700

Mr. Harley has advocated an increased sulphur allowance in specifications for piston rings. To show what is possible in this direction the following tests of metal which machined readily are noted:

Furnace	T.C.	C. C.	G. C.	Si.	S.	P.	Mn.
Crucible	3.00	.61	2.39	1.33	.24	.66	.74
Cupola	3.17	.73	2.44	1.24	.24	.55	.75

Tensile Strength

42,560 lbs. per sq. in.
42,000 lbs. per sq. in.

Speaking of the manufacture of pots from chill molds the author says that it is necessary to insure a uniform composition of the molten metal. It also is essential to consider the thickness of the mold in relation to the thickness of the pot. Metal cast into a warm chill gives different results from that cast into a cold chill, and for this reason the temperature of the chill must be kept fairly constant. The results also are affected by the pouring temperature of the metal. Pots were made of metal of approximately the same analysis, which was poured at the same temperature. Metal poured into the cold mold gave a ring which was too hard to machine, while the core of the pot poured into the hot mold was too soft to produce rings of the requisite quality.

In sand-cast pots the metal had a higher percentage of combined carbon than when similar metal was cast into chill molds which were either hot or cold. When it was desired to secure a higher percentage of combined carbon it was found necessary to increase the percentage of phosphorus from that usually found in hematite pig iron, which is a low-phosphorus iron corresponding closely to what is known as malleable bessemer iron in this country. The following table shows the amount of combined carbon in rings cast by the three different methods:

Per Cent Combined Carbon		
Sand cast	Hot chills	Cold chills
.47	.34	.39
.48	.36	.35
..	.34	.38
..	..	.38
.48	.23	.35

The author cites two semisteel rings cast from cupola metal in chill molds as showing the effect of total carbon on the metal. In the one ring the total carbon was 3.49 while in the other ring the total carbon was only 3.21. The first ring gave satisfactory results, but the metal with the lower total carbon chilled too deep. The complete analysis of these irons is as follows:

	Good	Chill too deep
Total Carbon	3.49	3.21
Combined Carbon	.36	.43
Graphitic Carbon	3.13	2.78
Silicon	2.18	2.07
Sulphur	.09	.096
Phosphorus	.06	.066
Manganese	.99	.76

Results of tests as shown in the following table are given as representative of a semisteel which had showed good results in chill-cast pots.

Calculated Analysis

T. C.	C. C.	G. C.	Si.	S.	P.	Mn.
2.35	..	..	2.83	.061	.384	1.00

Actual Analysis

3.40	.55	2.85	2.62	.107	.44	.91

Average of 61 Tests

Diameter of ring	3.719 in.
Width of ring	.1992 in.
Radial thickness	.142 in.
Extension at 22,400 tons per sq. in.	.162 in.
Permanent set	.013 in.
Total extension	.433 in.
Breaking load in lbs. per sq. in.	45,700

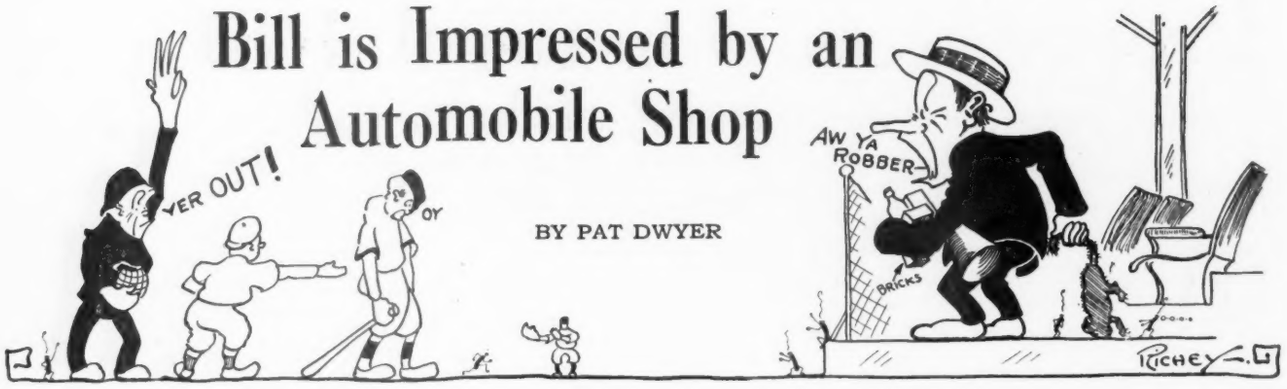
Typical analyses of iron suitable for pots cast in the three different manners are given as indicated in the following table:

	Sand cast	Chill cast	Rotary chill
Total Carbon	3.38	2.93	3.43
Combined Carbon	.78	.76	.73
Graphitic Carbon	2.60	2.17	2.70
Silicon	1.70	2.63	1.86
Sulphur	.107	.063	.098
Phosphorus	1.05	.14	1.00
Manganese	.63	.65	.995
Tensile Strength			
Pounds per sq. in.	37,300	45,900	35,200

Mr. Harley concludes by stating the qualities he considers necessary in good piston rings. They must have sufficient strength to withstand the stresses set up; they also must possess adequate resilience or minimum permanent set in the cold condition, and these qualities must be retained at the higher temperatures of the internal-combustion engine. Further, the metal must be of the proper texture to give it good wearing qualities, and finally, the design and method of producing finished rings must be such that the rings will exert an adequate and uniform pressure on the cylinder.

Henry R. Kent & Co., engineers and constructors have removed their offices from 141 Broadway, New York, to 5 Erie avenue, Rutherford, N. J.

Bill is Impressed by an Automobile Shop



BY PAT DWYER

WHEN I state that Bill is a ball fiend, I am violating no confidence. *Fan*, I believe is the proper and accepted term for those who take an active and pronounced interest in the doings of the Red Sox, White Sox, Pirates, Pelicans, Pikers and other aggregations of athletic gentlemen who so gallantly perform—for a consideration—in the ball parks of our large centers. Fan is an abbreviation of fanatic and if the word was not used in the abbreviated form it would serve as a proper term for describing Bill; but since it has been shortened to a fan and is therefore not expressive enough, I think fiend is a better definition.

Bill does not own stock in any of the ball clubs, he does not even know any of the players personally and yet to hear him talk you would be led to believe that the members of one particular ball club, individually and collectively had Bayard of knightly fame lashed to the mast, while their opponents also collectively and individually were nothing but a band of mercenaries who would stop at nothing from bribery to murder *a la carte* in their race for the pennant. Under ordinary circumstances he is a quiet, law abiding citizen, perfectly willing that others should share the privileges he enjoys under the provisions of the Constitution. However, from remarks he has made at various times when engaged in discussing the base ball situation I am led to believe that if some of the gentlemen, who do not find favor in his eyes, were to fall in a well or get lost in the Great Dismal Swamp, or fall a victim to the hook-worm while on their southern training trip he would be inclined to give three of those rousing cheers.

The base ball season had not been long under way in this present year of grace 1920, and the year 2 according to Cincinnati chronology, when Bill suggested one day that I should accompany him to the lists and see one of these tournaments. I did so and derived more pleasure from the way in which Bill and other gentlemen of pronounced and outspoken convictions conducted themselves during the progress of the game than I did from watching the game itself. On the way home Bill played the game over again, analyzing the different strategical moves and showing how the score could have been turned end for end if a certain combination had only been handled in some other way.

I suggested that he was wasting his time memorizing the events of the game because, no matter at what conclusion he arrived by juggling the points around in his mind, it would have no effect on the score which was already a matter of record.

"Quite so," said Bill, "quite so; but did you ever consider what a slow old world this would be if people always were satisfied to accept everything that happened and never tried to improve conditions? Look at this base ball business for instance. It is a highly developed and specialized industry. The players pass through many cruel years of training out in the bushes before they are considered worthy material by the ivory hunters. They finally come to be the cream of a profession and as a result, millions of people cheerfully deposit anything from four bits to four dollars for the pleasure of seeing them go through their evolutions. You will find the same conditions prevailing in every line of business. The best goods bring the highest prices and the production of the best goods is based on the trinity of power, organization and knowledge.

"Men long have built foundries bought foundries, acquired foundries, or had foundries wished on to them, who have had no training whatever in the business. They have thought, poor souls, that all they had to do was to get a cupola, an old building, some pig iron, a pile of sand and a few molders, and their fortunes were made. They are not in the game long before they discover that any old building will not do; that cupolas are as temperamental as prima-donnas; that there is pig iron—and pig iron; that stove plate and rolling mill housings can not be made in the same grade of sand; and that there are molders and near molders and others again that are not even distantly related. They discover that molding machines when not properly supervised, turn out more scrap than castings. In fact, for an amateur, a foundry is a profitable business to avoid.

"There are foundries that resemble nothing so much as great ant hills when they are overturned. Hundreds of insects running every way; all feverishly busy; but getting nowhere. There is no central, directing authority, there is no organization and the result is confusion.

"There are others so thoroughly organized, supervised, card-indexed and classified that they defeat their own object. There is the Great High Mogul who cannot think in figures less than a million. The first assistant condescends to view five hundred thousand. The second assistant is graciously pleased to toy with deals and ventures in the one hundred thousand dollar class occasionally. To maintain their health and conserve their efficiency under this killing strain it is necessary to have a large office building thickly populated with clerks and stenographers. A fireproof addition or annex is provided in which to keep the filing cabinets. There is a superintendent over every 20 men in the shop and a foreman over every two. Each of these men in authority every night has to fill in a form as long and as complicated as a federal income tax report.

"Some foundries are overdone; some are underdone and some are just about right. The tremendous volume of special castings required, due to the expansion of the automobile industry has induced many foundrymen to enter that field and some of the results they have achieved from concentrating on a specialized line are startling. I went through an automobile shop recently and although I had the evidence of my own eyes I

felt like the man who insisted 'There ain't no such animal.'

"The very exterior of the place conveys the idea of efficiency. The office is situated at one corner of the building and here the dominant note is struck which confronts and impresses one all through the plant. The keynote is simplicity, directness and co-operation.

"You might call it co-incidence, perhaps it is, but the shop runs as smoothly, swiftly and silently as any of the big cars in which its castings play such an important part. There is no confusion, no overlapping, and every one of the employes has a definite duty. The system of compensation insures for every man a square deal and a reward in proportion to his efforts. When a job is started, a price is set which appears mutually satisfactory to the men and the management. If after a time, and this frequently occurs, methods or rigging are improved so that the output is increased, the price is not cut. The price remains the same to the customer, the men earn more money for a day's work, and the firm sells more castings.

"In this way improvements are sought, sometimes suggested by the men and always welcomed. This has been one of the factors instrumental in raising the daily melt from 25 tons a day a few years ago to 150 tons at the present time. The active head of the firm and his immediate associates all are practical foundrymen. They served their time and grew up with the business. When any problem or trouble, question or inquiry turns up, they are right on the job and solve the difficulty themselves.

"To a person accustomed to the ordinary machinery foundry, the number of flasks put up here for a day's work seem enormous. A crew of six men put up, core and close 100 cylinder molds every working day. On occasions they have run up to 110. They work about eight hours. Consequently if you are interested and care to figure it out, you will find that a complete cylinder mold is turned out in exactly 4.3636 minutes. You will observe that I did not say about 4½ minutes. That is too vague to apply to a flying job like this. Nothing less than the time worked out to four decimal places would do justice to the speed at which these molds are produced.

SURPLUS OF BOSSES FOSTERS CONFUSION

"The molders begin work at 5:30 a. m. and are through about 2:30 p. m. Pouring commences between 9 and 10 a. m. and continues all day until about 5:30 p. m. The iron i distributed throughout the shop by two overhead traveling cranes which span the main bay and also by trolleys which run on the lower flanges of the main crane runway.

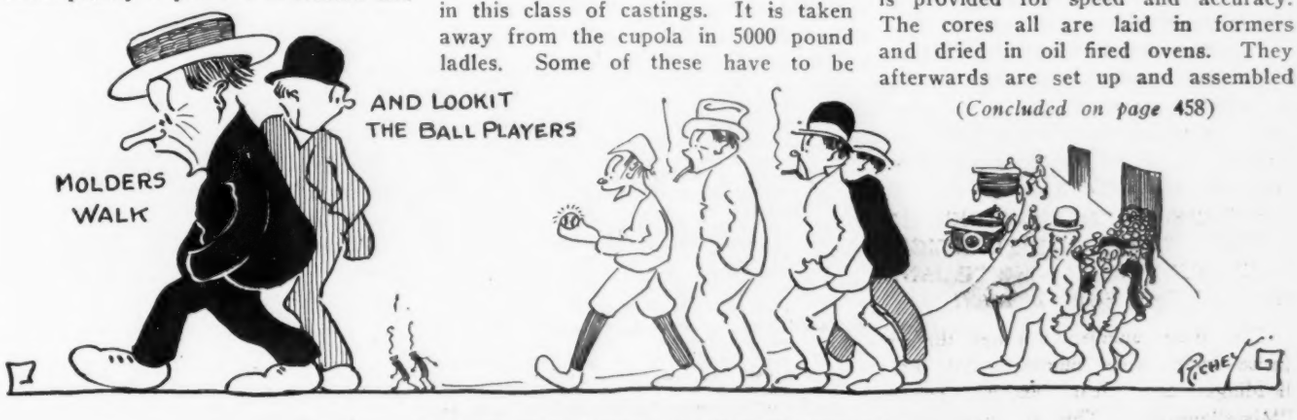
"One gang of men attends to the pouring, another gang follows shaking out, and still another takes the castings to the cleaning room which is situated in an adjoining building and is operated night and day. Here the castings are cleaned, tumbled, ground, sand blasted, tested and inspected. The defectives are sent to the scrap pile and the good ones shipped. Following up the men who remove the castings is the gang which wets down the sand and gets it ready for the morning.

"An interesting feature of this shop is the melting practice. The iron must be extremely hot in order to run the intricate and delicate sections found in this class of castings. It is taken away from the cupola in 5000 pound ladles. Some of these have to be conveyed quite a distance and the iron distributed afterward in hand ladles. All of this requires time. Consequntly, iron which would be considered hot enough for ordinary foundry work, here would not be considered at all. There are two cupolas, lined to 56 and 72 inches respectively. They use 500 pounds of coke to each 2000 pounds of iron in the small one and 750 pounds of coke to 3000 pounds of iron in the large one giving a ratio of 4 to 1. The small furnace melts about five tons an hour and the large one about 12.

"These figures seem extraordinary to the common or garden variety of foundryman accustomed to melt at the ratio of 9 or 10 to 1 and at about three times the speed indicated. In this case, however, speed and expense are secondary considerations. White hot, fluid iron is what they want and that is what they get. From 10 to 20 per cent steel is used in the mixture which consists of 60 per cent pig iron and 40 per cent scrap. The analysis of their castings is kept between 1.80 to 2 per cent silicon; manganese 0.40 to 0.50 per cent; sulphur 0.06 to 0.10 per cent and phosphorus 0.20 to 0.30 per cent.

"An idea of the important part which cores play in this kind of work may be gained from the fact that eight barrels of oil a day and three cars of sand a week are used in the core room. Every convenience here is provided for speed and accuracy. The cores all are laid in formers and dried in oil fired ovens. They afterwards are set up and assembled

(*Concluded on page* 458)



IF WISHES WERE FLIVERS ALL MOLDERS MIGHT RIDE

Standard Foundry Cost System—II

Cost Compilation, Expense and Burden Accounts Form the First Division—Tables Show Methods of Keeping Monthly Accounts and Profit and Loss Account, Also the Casting Cost Sheet

THE compilation of costs consists of two main divisions. The first is the compiling of the monthly statements of the various operating expense and burden accounts, which accounts give us a complete analysis of all indirect costs, and a monthly and average to date check on our predetermined rates.

The second division is the compiling of casting or class costs based on weights and direct labor cost of product turned out, using predetermined rates on all except the direct labor.

In compiling the costs of the first division, we combine with the actual compilation the operation of securing the figures for the necessary journal

COMPILED BY
C. E. KNOEPPEL & CO., INC.
NEW YORK

entries to make the proper transfers—we therefore will trace through the detail work necessary to accomplish all ends:

First Division

Expense and Burden Accounts

All time tickets, requisitions, and expense ledger charge slips are filed under their proper order numbers.

For the work of compiling the statements, there should be prepared ahead a skeleton statement for each account for a working paper with headings as follows: (Refer to statements shown later in this section.)

EXPENSE LEDGER—ORDER NO. —TIME TICKETS—REQUISITIONS —CHARGE SLIPS—MISCELLANEOUS—TOTAL FOR MONTH.

The order number indicates the expense code order number. All other headings are clear except possibly "Miscellaneous." This is suggested in case some foundry uses a transfer charge slip from some other department of the same company.

With these skeleton working statements ready, start in with the operating account, and

First:—Add time tickets under each order number setting total opposite proper order number and under "Time Tickets."

Find total for each section of expense or burden account as per sample statements. Find total for each account. Find total for all accounts, including power, light and heat, pattern, general expense, etc.

This total should agree with the total indirect labor shown by the payroll distributions.

The figures here found showing total for each department become the debits to same in the labor distribution journal entry, and with the addition of the amounts for each productive department of direct labor shown by the pay roll distribution, make up the complete journal entry for labor distribution for the month.

Second:—Add requisitions same way as time slips and enter.

The total for each account gives the figure for the debits side of the journal entry of distribution of material, the credit side being the figures accumulated before the requisitions were filed, where the amounts to be credited to each stock material account was found. This also gives a check on the accuracy of the work performed at all stages, as these figures must agree to make a balanced entry.

Third:—Add and enter the expense ledger charge slips exactly the same way. This will give the debits to the various expense and burden accounts, and the total *credit* to expense ledger account.

Note that this credit must equal the total of the debits as comes from the purchase register.

Journal entry No. 2 combines the second and third items here shown into one entry. They can be made separately if desired.

Fourth:—If some purely local method is installed to control charges from other departments through some "Deferred Charge" method use the column headed "Miscellaneous." Proceed as in other cases.

Fifth:—Without going into the detail of each, prepare monthly journal entries covering distribution of:

Liability insurance
Depreciation
Taxes
Fire insurance
And any other desired items.
(See journal entries for methods to use.)

Sixth:—Now close the accounts.

Power, light and heat
Pattern expense
General expense

distributing them as per directions elsewhere, making up proper journal entries of same.

Seventh:—We now have all items in our operating expense and burden accounts, and same can be completely footed.

Eighth:—Next get the necessary data of total metal poured; direct molding labor; direct coremaking labor; and total good castings.

Ninth:—Prepare journal entry and make entries on statements as follows: (Debit is to Work in Process.)

Melting Cost is credited with pounds of metal poured times the predetermined rate per pound.

Molding Burden-Direct Labor with direct labor times predetermined rate.

Molding Burden-Machine Hour with hours of machine work times predetermined rate.

Coremaking Burden-Direct Labor with direct labor times predetermined rate.

Coremaking Burden-Machine Hour with hours of machine work, times predetermined rate.

Finishing Cost with combined molding and core direct labor times predetermined rate.

Annealing Cost with weight good castings times predetermined rate.

Important Note.—There are two ledger accounts for each operating expense and burden account. One, named as those above, is for debits or adjustments of same only, and the other is for the credits through transfers to work in process each month. The object of this is to accumulate the burden amounts to date each month, also the burden credits—for use in the comparative statements. The difference between each pair of accounts is the over or under absorbed expense, carried to the profit and loss statement monthly, but not journalized except at yearly closing of books.

Tenth:—With all data now known, fill in and compute the comparative statements of each expense and burden account.

Table I

Casting Cost Sheet

Total metal poured	—— lbs. @ —— per lb.	——	
Less bad castings	—— lbs. @ —— per lb.	——	
Sprue	—— lbs. @ —— per lb.	——	
Net metal cost			——
Molding direct labor			——
Molding burden @ ——% of direct labor			——
Molding burden @ ——hrs. machine @ —— per hr			——
Net molding department cost			——
Coremaking direct labor			——
Coremaking burden @ ——% of direct labor			——
Coremaking burden @ ——hrs. machine @ —— per hr			——
Net coremaking department cost			——
Finishing cost @ ——% of combined molding & core direct labor			——
Annealing cost @ ——% per lb. of good castings			——
Total plant cost			——
If molding sand and flask cost is used separately, add to the foregoing.			
Molding sand cost —— lbs. poured @ —— per lb			——
Flask cost —— good castings @ —— per lb			——

Second Division

Compiling Casting and Class Costs

All time tickets representing the direct labor are filed under the order or class number. Weight records are known of weights of the castings to be figured as well as the sprue weights of same, and which castings weights are good—and bad.

The form shown in table I will then be followed either for individual castings of classes:

The credit of bad castings and sprue is usually given at some regular arbitrary price per pound, but of course closely approximating current value of scrap.

Different foundries use different methods depending on the nature of their work.

Class Costs

If class costs are used, a subsidiary record should be used for pricing sales for the month used as follows, and

TABLE II

Accounts Are Kept on a Monthly Basis

LABOR	MELTING COST LAST MONTH	CONVERSION THIS MONTH	MONTH OF THIS YEAR TO DATE
101. Foremen and assistants			
102. Timekeepers and other clerks			
103. Unloading melting materials			
104. Cupola or furnace labor			
105. Elevator and cranemen			
106. Breaking scrap			
107. Handling slag			
108. Testing materials and product			
109. Melting materials stores labor			
110. Sickness and accident relief			
111. General labor			
TOTAL			
Total Forward			

MELTING COST
CONVERSION

MONTH OF.....
FORWARD .....
MAINTENANCE OF PROPERTY

121. Buildings .....
122. Cupolas and furnaces.....
123. Converters .....
124. Elevators, cranes and conveyors.....
125. Electrical apparatus .....
126. Pipe and power lines.....
127. Platform and stairways.....
TOTAL .....

SUPPLIES

141. Aluminum .....
142. Brick .....
143. Clay .....
144. Coke .....
145. Electrodes .....
146. Fuel oil .....
147. Lime .....
148. Limestone .....
149. Lining materials .....
150. Sand .....
151. Miscellaneous supplies .....
152. Laboratory expenses .....
TOTAL .....

APPORTIONED CHARGES .....
Bonus .....
Depreciation .....
General expenses .....
Insurance .....
Power, heat and light.....
Taxes .....
TOTAL .....
TOTAL CONVERSION COST.....

METAL COST

METALS

Pig iron .....
Purchased scrap .....
Iron scrap .....
Ferromanganese .....
Ferro silicon .....
Iron ore .....
TOTAL METAL COST.....
TOTAL MELTING COST.....

To WORK-IN-PROCESS account.
Total poured
lbs. @ .....per lb.....
Balance to PROFIT AND LOSS ACCOUNT....

MOLDING BURDEN—DIRECT LABOR

MONTH OF.....

INDIRECT LABOR

201. Foreman and assistants.....
202. Timekeepers and other clerks.....
203. Cutting sand and preparing floors.....
204. Closing and clamping molds.....
205. Drying molds .....
206. Runner cups .....
207. Broken molds .....
208. Carrying patterns and flasks.....
209. Pouring .....
210. Shaking out .....
211. Taking out refuse and scrap.....
212. Cleaning and sweeping.....
213. Crane operator .....
214. Idle time .....
215. Sickness and accident relief.....
216. Pattern storage labor.....
217. Expenses due to errors and defects....
218. General labor .....
TOTAL .....

MAINTENANCE AND SUPPLIES

221. Buildings .....
222. Molding machines .....
223. Jarring machines .....
224. Air hoists .....
225. Cranes .....
226. Electrical apparatus .....
227. Shop fixtures .....
228. Pipe and power lines.....
229. Small tools .....
230. Gaggers, chills, chaplets, and bolts...
231. Nails .....
232. Lamp bulbs .....
233. Patterns .....
234. Molding sand .....
235. Flasks .....
236. Nondurable tools .....
237. Metal arbors and cores.....
238. Miscellaneous supplies and expenses..
TOTAL .....

APPORTIONED CHARGES

Bonus .....
Depreciation .....
General expense .....
Insurance .....
Pattern expenses .....
Power, heat and light.....
Taxes .....
TOTAL .....
TOTAL MOLDING BURDEN.....
To WORK-IN-PROCESS account
@ % of productive labor..
Balance to PROFIT AND LOSS account.....

MOLDING BURDEN—MACHINE HOUR

MONTH OF.....

DIRECT CHARGES

251. Maintenance of molding machines.....
252. Maintenance of jarring machines.....
TOTAL .....

APPORTIONED CHARGES

Depreciation .....
Power, light and heat.....
TOTAL .....
TOTAL MOLDING BURDEN—MACHINE HOUR .....
To WORK-IN-PROCESS account
hrs. @ per hour.....
Balance to PROFIT AND LOSS account.....

IF USED SEPARATELY

MOLDING SAND COST

MONTH OF.....

234–1 Molding sand .....
234–2 Unloading molding sand.....
234–3 Mixing molding sand.....
234–4 Maintenance of mixers.....
234–5 Miscellaneous supplies .....
234–6 Miscellaneous expenses .....
TOTAL .....
To WORK-IN-PROCESS account lbs.
metal poured @ per pound.....
Balance to PROFIT AND LOSS.....

FLASK COST

MONTH OF.....

235–1 Wood flasks and bottom boards.....
235–2 Snap flasks and jackets.....
235–3 Metal flasks .....
235–4 Flask plates .....
TOTAL .....
To WORK-IN-PROCESS account lbs.
good castings @ per pound.....
Balance to PROFIT AND LOSS.....

COREMAKING BURDEN—DIRECT LABOR

MONTH OF.....

LABOR

301. Foremen and assistants.....
302. Timekeepers and other clerks.....
303. Inspecting cores .....
304. Unloading core sand.....
305. Wheeling and mixing core sand.....
306. Loading and tending ovens.....
307. Handling cores .....
308. Repairing cores .....
309. Crane operator .....
310. Storing cores .....
311. Sickness and accident relief.....
312. Exp. due to errors and defects.....
313. General labor .....
314. .....
TOTAL .....

MAINTENANCE AND SUPPLIES

321. Buildings .....
322. Coremaking machines .....
323. Sandmixing machines .....
324. Electrical apparatus .....
325. Core ovens .....
326. Shop fixtures .....
327. Pipe and power lines.....
328. Cranes .....
329. Plates .....
330. Small tools .....
331. Core boxes .....
332. Fuel consumed .....
333. Core sand .....
334. Clay .....
335. Core compound and oil.....
336. Flour .....
337. Silica wash .....
338. Rods, wires, nails.....
339. Misc. supplies and expenses.....
TOTAL .....

APPORTIONED CHARGES

Bonus .....
Depreciation .....
General expenses .....
Insurance .....
Pattern expenses .....
Power, heat and light.....
Taxes .....
TOTAL .....
TOTAL COREMAKING BURDEN....
To WORK-IN-PROCESS account @
% of Productive labor....
Balance to PROFIT AND LOSS account.....

COREMAKING BURDEN—MACHINE HOUR

MONTH OF.....

DIRECT CHARGES

351. Maintenance of coremaking machines...

APPORTIONED CHARGES

Depreciation .....
Power, light and heat.....
TOTAL .....
TOTAL BURDEN MACHINE HOUR—
To WORK-IN-PROCESS account hrs.
@ per hour.....
Balance to PROFIT AND LOSS.....

FINISHING COST

MONTH OF.....

LABOR

401. Foremen and assistants.....
402. Timekeepers and other clerks.....
403. Inspectors .....
404. Crane operator .....
405. Handling good product.....
406. Taking out refuse and scrap.....
407. Cleaning and sweeping.....
408. Unloading miscellaneous materials.....
409. Expense due to errors and defects.....
410. Sickness and accident relief.....
411. General labor .....
412. Shipping expense labor.....
TOTAL .....

MAINTENANCE AND SUPPLIES

421. Buildings .....
422. Tumblers .....
423. Grinders .....
424. Machinery .....
425. Air tools .....
426. Cranes .....
427. Electrical apparatus .....
428. Sand blast apparatus.....
429. Cutting and welding equipment.....
430. Shop fixtures .....
431. Pipe and power lines.....
432. Other equipment .....
433. Sand for sand blast.....
434. Non-durable tools .....
435. Electric lamps .....
436. Emery wheels .....
437. Carbide, hydrogen and oxygen.....
438. Welding material .....
439. Shipping expense materials.....
440. Inspection .....
441. Other materials and expenses.....
TOTAL .....
Total Forward .....

FINISHING COST

MONTH OF.....
FORWARD .....
APPORTIONED CHARGES
Bonus .....

(*Continued on page* 440)

TABLE II

Accounts Are Kept on a Monthly Basis

(*Concluded from page* 439)

Depreciation .....
General expense .....
Insurance .....
Power, heat and light.....
Taxes .....
TOTAL .....

DIRECT OPERATIONS

Caulking .....
Chipping .....
Cleaning .....
Cutting .....
Grinding .....
Sand blasting .....
Welding .....
Etc. .....
TOTAL .....
TOTAL FINISHING COST.....
To WORK-IN-PROCESS account @
% of total molding and core productive labor .....
Balance to PROFIT AND LOSS account.....

ANNEALING COST

MONTH OF.....

501. Foremen .....
502. Oven tenders .....
503. Packing labor .....
504. Packing materials .....
505. Expenses due to errors and defects....
506. Boxes .....
507. Fuel consumed .....
508. Maintenance of ovens.....
509. Maintenance of electrical apparatus....
510. Maintenance of buildings.....
511. Maintenance of miscellaneous equipment
512. Sheet iron used in muffle furnace....
513. Miscellaneous supplies .....
TOTAL .....

APPORTIONED CHARGES

Bonus .....
Depreciation .....
General expenses .....
Insurance .....
Power, heat and light.....
Taxes .....
TOTAL .....
TOTAL ANNEALING COST.....
To WORK-IN-PROCESS account
Basis of lbs. good castings @ a lb.....
Balance to PROFIT AND LOSS account.....

POWER, HEAT AND LIGHT EXPENSES

MONTH OF.....

601. Power plant and substation labor.....
602. Maintenance of power plant equipment..
603. Maintenance of substation equipment..
604. Oils and waste.....
605. Electric lamps .....
606. Fuel consumed .....
607. Maintenance of power plant buildings..
608. Maintenance of boiler and equipment..
609. Current purchased .....
610. Miscellaneous expense .....
TOTAL .....

APPORTIONED CHARGES

Bonus .....
Depreciation .....
Insurance .....
Taxes .....
TOTAL .....
TOTAL POWER, HEAT AND LIGHT EXPENSES .....

Transferred to following accounts:
Melting cost ..... % .....
Molding Burden—Direct Labor... % .....
Molding Burden—Machine Hour.. % .....
Coremaking Burden—Direct Labor % .....
Coremaking Burden—Machine Hour % .....
Finishing cost ..... % .....
Annealing cost ..... % .....
Pattern shop expense..... % .....
General expenses ..... % .....
100% .....

PATTERN SHOP EXPENSES

MONTH OF.....

701. Foremen .....
702. Alterations and repairs to patterns....
703. Alterations and repairs to core boxes..
704. Making new or replacing old wood flasks
705. Maintenance of snap flasks.....
706. Maintenance of buildings.....
707. Maintenance of machinery.....
708. Maintenance of shop fixtures.....
709. Miscellaneous lumber .....
710. Nondurable tools .....
711. Miscellaneous supplies and expenses....
TOTAL .....
TOTAL PATTERN SHOP EXPENSES

Transferred to following accounts:
Value in Account 702 to Account 233 ....
Value in Account 703 to Account 331 ....
Value in Account 704 to Account 235–1....
Value in Account 705 to Account 235–2....
Residue of $..... to
Molding burden ..... %....
Coremaking burden ..... %....
100%

GENERAL EXPENSES

MONTH OF.....

801. Salaries—Department Heads .....
802. Salaries—Clerical .....
803. Yard labor .....
804. General labor .....
805. General repair men.....
806. Sickness and accident relief.....
807. Printing and stationery.....
808. Office supplies .....
809. Traveling expenses .....
810. Telephone and telegraph.....
811. Car demurrage .....
812. General stores expenses.....
813. Watchmen's expense .....
814. Blacksmith shop expense.....
815. Repair department expense.....
816. Trucking or teaming expense.....
817. Maintenance of office building.....
818. Maintenance of buildings and equipment (general) .....
819. Maintenance of yards, fences and grounds .....
820. Maintenance of tracks.....
821. Repairs on returned material.....
822. Miscellaneous expenses .....
TOTAL .....

APPORTIONED CHARGES

Bonus .....
Depreciation .....
Insurance .....
Taxes .....
General charge .....
(If a part of a company of many departments.)
TOTAL .....
TOTAL GENERAL EXPENSES.....

Transferred to following accounts:
Melting cost ..... % ....
Molding burden ..... % ....
Coremaking burden ..... % ....
Finishing cost ..... % ....
Annealing cost ..... % ....
100%

for the reasons given.

It is necessary to close up all classes monthly. Of course *some* castings are not complete—are in process. So, therefore, no one month's figures mean much as against the average of a number of months.

Also, some castings at one month's cost are shipped during the *next* month, when the *month's* class cost most likely is different.

So, therefore, a running record for each class should be kept in the following manner:

	Pounds	Per Lb.	Amount
Balance	0000	000	0000
Produced this month..	00000	000	00000
Total	00000	000	00000
Shipped	00000	000	00000
Balance	0000	000	0000

By this the unshipped tonnage—at its value is carried over. The production *at the cost for the month* is added, which gives us a total and thereby an *averaged* cost. This cost per pound we use in pricing the shipments for the month, leaving a balance forward unshipped to repeat next month. This will insure equitable pricing of sales, and keep the inventories at proper values.

Individual Costs

In the case of individual casting costs, the troubles experienced in class cost are not apparent, as each casting order is on its own basis. It is simply a matter of costing the shipments as made by the use of weights and direct labor with predetermined costs of expenses and burdens.

Closing Costs of Orders or Classes

We now must prepare our journal entries and use the cost compiled in the second section.

First:—An accumulation of all bad castings and sprue must be made for the month. This will be the total of this deduction in the cost sheets. This gives us the journal entry to credit work in process and debit scrap. This also comes from inspector's reports.

Second:—The cost of completed castings will be transferred from work in process to finished castings—if put into stock or to cost of castings sales if castings are not stocked. This is journal entry No. 12 or 13.

Third:—If individual castings costs are figured, this cost should be entered on the invoices and from there recapped, in order to be sure that each sale is priced.

Fourth:—If class costs are used, a recap of shipments under each class will be made, and then priced as per method under "class costs—individual costs." In both this and the preceding entry, remember the journal entry.

Monthly Cost, Profit and Loss and Balance Sheets

Immediately following are forms of cost sheets for all expense and burden accounts, profit and loss and balance sheet.

If the form of statements is carried out, and all previous directions, no trouble will be experienced.

Each operating statement shows place for credit of predetermined accounts, and shows the balance under or over absorbed. These balances are carried into the profit and loss credits red, and debits black.

Then insert the administrative and selling costs as figured on the working sheets, as well as sales, financial items, etc., and the profit or loss is arrived at.

From the trial balance fill in all the items on the balance sheet, and this should show same results as the profit and loss sheet.

* * * * * *

A method of accounts which is not the means of pointing the way to reforms is a failure. An industrial plant which fails to have such a method is far behind the times. Nor does an

Table III

Heads for Monthly Comparative Statistical Reports

Comparative Cost of Melt

1919 MONTH	METAL POURED MONTH	METAL POURED TOTAL	COST OF MELT MONTH	COST OF MELT TOTAL	COST PER POUND MONTH	COST PER POUND AVERAGE

Comparative Cost of Conversion

1919 MONTH	METAL POURED MONTH	METAL POURED TOTAL	CONVERSION COST MONTH	CONVERSION COST TOTAL	COST PER POUND MONTH	COST PER POUND AVERAGE

Comparative Per Cent Molding Burden—Direct Labor To Direct Labor

1919 MONTH	DIRECT LABOR MONTH	DIRECT LABOR TOTAL	MOLDING BURDEN MONTH	MOLDING BURDEN TOTAL	DEPARTMENT % MONTH	DEPARTMENT % AVERAGE

Comparative Cost Molding Burden—Machine Hour To Actual Machine Hours

1919 MONTH	ACTUAL MCH. HOURS MONTH	ACTUAL MCH. HOURS TOTAL	MACHINE COST MONTH	MACHINE COST TOTAL	COST PER HOUR MONTH	COST PER HOUR AVERAGE

Comparative Molding Sand Cost

1919 MONTH	METAL POURED MONTH	METAL POURED TOTAL	SAND COST MONTH	SAND COST TOTAL	COST PER POUND MONTH	COST PER POUND AVERAGE

Comparative Flask Cost

1919 MONTH	GOOD CASTINGS MONTH	GOOD CASTINGS TOTAL	FLASK COST MONTH	FLASK COST TOTAL	COST PER POUND MONTH	COST PER POUND AVERAGE

Comparative Per Cent Coremaking Burden—Direct Labor To Direct Labor

1919 MONTH	DIRECT LABOR MONTH	DIRECT LABOR TOTAL	COREMAKING BURDEN MONTH	COREMAKING BURDEN TOTAL	DEPARTMENT % MONTH	DEPARTMENT % AVERAGE

Comparative Cost Coremaking Burden—Machine Hour To Actual Machine Hours

1919 MONTH	ACTUAL MCH. HOURS MONTH	ACTUAL MCH. HOURS TOTAL	MACHINE COST MONTH	MACHINE COST TOTAL	COST PER HOUR MONTH	COST PER HOUR AVERAGE

Comparative Per Cent Finishing Cost to Molding and Core Direct Labor

1919 MONTH	MLDG. & CORE PROD. LABOR MONTH	MLDG. & CORE PROD. LABOR TOTAL	FINISHING COST MONTH	FINISHING COST TOTAL	DEPARTMENT % MONTH	DEPARTMENT % AVERAGE

Comparative Annealing Cost

1919 MONTH	GOOD CASTINGS MONTH	GOOD CASTINGS TOTAL	ANNEAL COST MONTH	ANNEAL COST TOTAL	COST PER POUND MONTH	COST PER POUND AVERAGE

elaborate method accomplish more than a simple method, if the management *fails to use the figures set forth.*

Costs may *cost,* or may become an *investment.* It's up to the *use* of the figures whether the cost system in a plant is an *expense* or an *investment.* You can make it an investment if you will—and a very profitable one by getting everyone interested in every detail—in every item of every expense and burden account.

Bonuses or prizes may be worked out—and almost any method at all when you have the figures and use them.

Besides that—you *know* your costs.

Special Note—Financial Expense

Theoretically, all interest and discounts are straight profit and loss items.

Interest on loans in banks are but payments on account of insufficient capital, and therefore are in place of what otherwise would be stock dividends.

Cash discounts given are really the same as interest paid, and are *not* selling expenses.

However, many companies desire to include interest expenses as a part of the administrative expense in their costs, on the theory that the interest has to be earned and the best way to be more assured is to thus include it in the cost.

In the statement of profit and loss shown in Table IV, the financial section stands alone and may or may not be combined with the administrative expense, according to the desires of the officers of the company.

Monthly Comparisons

Monthly comparative statistical reports as shown in Table III should be compiled and are derived from the monthly reports.

Use of Burden and Expense Statements

The burden and expense statements

TABLE IV

Profit and Loss Account

Month of 1919

(Credits Red—Debits Black)

	Total to Date	Current Month	Last Month	Inc. in Red Dec. in Black
SALES—CASTINGS				
Total				
Cost of castings sales				
MISCELLANEOUS SALES				
Cost of miscellaneous sales				
Total				
TOTAL				
Less freight out on sales				
GROSS PROFIT				
PLANT BALANCES				
Melting cost				
Molding burden—direct labor				
Molding burden—machine hour				
Coremaking burden—direct labor				
Coremaking burden—machine hour				
Finishing cost				
Annealing cost				
Molding sand cost				
Flask cost				
Total Plant Balances				
NET MFG. PROFIT FORWARD				
ADMINISTRATIVE EXPENSE				
Executive salaries				
Office salaries				
Office supplies and expenses				
Traveling expenses				
Association dues				
Charities				
Miscellaneous expenses				
Total Administrative				
SELLING EXPENSE				
Selling salaries				
Commissions				
Traveling expenses				
Office supplies and expenses				
Advertising				
Telephone and telegraph				
Postage				
Miscellaneous expenses				
Total selling expenses				
FINANCIAL				
Interest paid				
Interest received				
Cash discount allowed customers				
Cash discount taken on purchases				
Total financial				
TOTAL ADM. SELLING & FIN. FWD				
NET MANUFACTURING PROFIT FORWARD				
TOTAL ADMIN. SELLING & FIN. FWD				
MISCELLANEOUS				
Insert here any miscel. a/cs such as				
Net real estate P. or L. (If any owned or rented)				
Loss on bad accounts				
Adjustment a/c (If any adjustments are necessary for any purpose)				
Total Miscellaneous				
TOTAL ADMIN., SELLING, FINANCIAL AND MISCELLANEOUS				
NET PROFIT OR LOSS FOR MONTH				

*These heads extend over all accounts in this table.

ASSETS	
Cash on hand and in banks	
Bills receivable	
Accounts receivable	
Investments	
Total Current Assets	
Raw materials and in process	
Machinery and equipment	
Real estate and buildings	
Total Fixed Assets	
Prepaid insurance	
Prepaid taxes	
Prepaid interest	
Total Deferred Assets	
Patents	
Goodwill	
Total Intangible Assets	
TOTAL ASSETS	
LIABILITIES	
Bills payable	
Accounts payable	
Accrued items	
Total Current Liabilities	
Bonds payable	
Mortgages payable	
Total Fixed Liabilities	
Reserves	
Capital stock preferred	
Capital stock common	
Total Capital Liabilities	
Surplus	
Less inc. and ex. prof. tax for	
Dividends preferred	
Dividends common	
Total Surplus Deductions	
Add Profits to (Previous Mo.)	
Profit for (Current Mo.)	
Total Surplus Additions	
Net Surplus	
TOTAL LIABILITIES	

contain almost unlimited opportunities for cost cutting, as well as giving the figures for the adjusting of standard rates of burden for each operating department.

The indirect expense is really the greater and more elusive part of the cost of product. This is naturally so, as the direct labor, being charged to the various pattern or order numbers is in much more concrete and watchable form, and is of course the center of all piece work, bonus, or any other kind of stimulus producing effort.

But the overhead—the *burden*, for such it is in grim fact, is not only the greatest feature, but is the most neglected feature in the great majority of plants. Why?

The most common reason for neglect in most plants is on account of lack of knowledge of how to handle burden in a manner to show it up in usable form.

It has been the aim of this bulletin to make this perfectly clear; to supply definite directions which will permit anyone to go ahead. If the accounts do not quite fit, anyone can follow the principle and make up accounts as they desire.

So, the *twofold* feature of this bulletin should be carefully studied.

First:—It will give costs.

Second:—It will give costs that can be used for practical and cost cutting purposes.

The monthly comparisons give the unit costs, and percentages for each month and the average to date for the year. Monthly figures will, of course, vary; but the average to date is the figure to watch. If it gets off very far from the standard, then the standard will have to be changed. But don't worry for two or three months until you see how it is really running.

Section VI
Journal Entries

The following sequence of journalizing should be followed in order to distribute the various details into the cost of production and reflect the condition properly on the general ledger.

1. Payroll.
2. Materials and supplies.
3. Liability insurance.
4. Depreciation.
5. Taxes.
6. Fire insurance.
7. Power, heat and light.
8. Pattern shop expenses.
9. General expenses.
10. Departmental expenses.
11. Reversing foundry scrap.
12. Finished castings.
13. Shipments.

The details of the journal entries required are illustrated in the text immediately following.

1. PAYROLL:
Debit—
Work in process (direct labor).
Cost of melt (conversion labor).
Molding burden—direct labor.
Molding burden—machine hour.
Molding sand cost.
Flask cost.
Coremaking burden—direct labor.
Coremaking burden—machine hour.
Finishing cost.
Annealing cost.
Pattern shop expenses.
Power, heat and light expenses.
General expenses.
Credit—
Accrued payroll.
Purpose—
To distribute labor charges for current month
Source—
Direct labor charges are taken from the molding and coremaking pay roll sheets and should equal the total of all direct labor daily time tickets filed under production order or class numbers for the same period.
Indirect labor charges to cost and burden accounts are obtained from the compilation of indirect labor daily time tickets filed under the various expense account numbers as described in Section III. The values thus accumulated by summarizing the labor tickets must agree with the total of the pay roll for the same period.
Debit—
Cost of melt (Melting and conversion materials).
Molding burden—direct labor.
Molding burden—machine hour.
Molding sand cost,
Flask cost.
Coremaking burden—direct labor.
Coremaking burden—machine hour.
Finishing Cost.
Annealing Cost.
Pattern shop expenses.
Power, heat and light expenses.
General expenses.
Credit—
Melting Stock—metals.
1. Pig iron.
2. Purchased scrap.
3. Foundry scrap.
4. Ferromanganese.
5. Ferrosilicon.
General stores.
Any other controlling material accounts.
Expense ledger.
Purpose—
To distribute material requisitions and expense ledger charges for current month.
Source—
These charges are derived from a monthly summary of cupola or furnace reports, material requisitions and expense ledger charge slips representing materials consumed or purchases made during the current month distributed to the cost and burden accounts.

3. LIABILITY INSURANCE:
Debit—
Cost of melt.
Molding burden—direct labor.
Molding burden—machine hour.
Coremaking burden—direct labor.
Coremaking burden—machine hour.
Finishing Cost.
Annealing Cost.
Pattern shop expenses.
Power, heat and light expenses.
General expenses.
Credit—
Unexpired insurance.
Purpose—
To distribute pro-rata amount of liability insurance premiums to current month.
Source—
This distribution is based on an estimated monthly amount sufficient to absorb the yearly total of liability insurance premiums.

House Publication Attracts Apprentices

MANY of the larger manufacturers publish monthly papers in the interests of their employes to give them a feeling of closer association with the company and its ideals. Such organs often are largely personal affairs, giving stories about individuals which are of interest to those same persons and their friends, but are of no value to the employes who do not intimately know the parties mentioned. In this way the usefulness of the paper is limited and after the first few issues the number of persons who read it dwindles. Usually at the start there is strong enthusiasm among a limited number of the employes who act as reporters to gather news, but this interest soon lags and the editor alone must keep up enthusiasm and secure enough material to fill the required space.

The personal feature in company magazines frequently is reinforced by educational matter which does not always relate to the work of the particular plant and which can be easily secured elsewhere. Further, the paper is used by some to bring company announcements to the attention of the employes, supplementing the bulletin board to which attention is not regularly given by all employes.

The *Westinghouse Machine News*, published monthly by the Westinghouse Electric & Machine Co., at its South Philadelphia works, Lester, Pa., has had a broader appeal. It has been a practical help to the employment department through published articles describing work in the different departments which interpret to the outsider the methods and mode of life within the shop. An article in the March number describing foundry practice illustrates the way by which the prospective molder is appealed to through the house organ. This article is headed by an illustration showing molders and their helpers. Below this illustration the name of each man is given in order, so that his picture and name may be associated. This appeals to all the men as well as to their relatives and friends, and is purely of a local nature.

The descriptive matter accompanying this article starts with an introduction in a lighter vein, and then proceeds to describe the work of the molder in a simple manner so that a person not acquainted with foundry work may get an idea of what it entails. An idea of the style in which this is written may be gained from the following:

The work of the molder is peculiar. He receives a wooden pattern which is shaped like the part of a machine or casting, and he is given sand and gravel. With these he proceeds to make a mold. Now, what is a mold? A mold is similar to a strait-jacket, but made of sand. It is composed of two parts—a drag and a cope. The drag is made by ramming sand about the

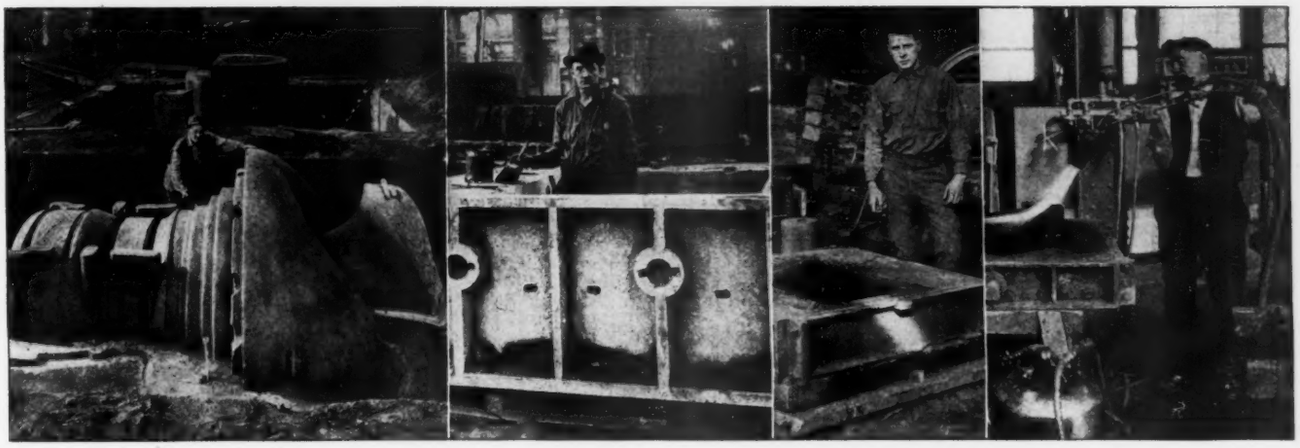


FIG. 1—THE ABOVE ILLUSTRATION IS DESCRIBED IN THE MACHINE NEWS AS FOLLOWS—LEFT TO RIGHT—A LARGE DRAG—THE OUTSIDE SHAPE OF THE DRAG WILL BE THE INSIDE SHAPE OF THE CASTING—A MEDIUM SIZE COPE—THE INSIDE SHAPE OF THE COPE IS THE OUTSIDE SHAPE OF THE CASTING—A SMALL SIZE DRAG AND, RIGHT, ITS COPE BEING DRIED WITH AN ACETYLENE TORCH—THE COPE WILL BE PLACED ON THE DRAG AND THE SPACE BETWEEN THE TWO WILL BE THE THICKNESS OF THE CASTING

under side of the wooden pattern. The sand takes on the form of the inside shape of the pattern. With a finished casting, it would look like a casting turned inside out. The wooden pattern is made as thick as a casting is to be. The cope is made of sand which has been evenly rammed on the upper side of the same wooden pattern. The inside shape of the cope will be the outside shape of the finished casting.

The article continues to describe all the operations in making a casting including melting the metal. The work of the craneman in relation to the molder also is described. Fig. 1 shows the character of illustrations used to visualize the molder's work to readers not familiar with the foundry. The caption below the figure is the same as that given in the *Machine News*. It tells the story of the illustration simply and in a manner to interest the uninitiated.

A paragraph following the description of the molder's work mentions the apprentice course and appeals to the boys to learn the molder's trade in the foundry of the Westinghouse Co. This is followed by a short discourse on the advantages of the molder's trade. The article ends with a description of the advantages of the Westinghouse foundry. These three paragraphs follow:

The Molders and Their Work

The molders go through a four-year apprenticeship course and after that it really takes about two years before they are first-class molders. Mr. Suess, foreman of the foundry, said that in the past five years no American boys are anxious to learn the molders' trade. They think that it is too dirty a job. Mr. Suess doesn't think that, nor do his two boys, who are working at this trade in our foundry.

A Molder is a Talented Workman

The molders' trade dates back to 25 A. D. and it is one that cannot be easily replaced by machinery. The work is really an art. The illustration of the molds shows the neat work made by molders. To be a really first-class molder it is necessary to know something of pattern-making, metallurgy, chemistry, to know how to analyze sands, etc.; in fact, be an all-around man.

Ours is a Model Foundry

Mr. Haas, foreman of the large molding department, learned his trade in Europe and he has worked in many shops. He comments that the working conditions in our foundry could not be better—excellent light, good ventilation, clear atmosphere—as proof, all of the photographs illustrated herewith were taken during busy working hours, excepting the group of molders, who were photographed during lunch hour. There are many convenient lockers for both tools and clothing and hot and cold shower baths are provided in the washroom.

Such information as this appeals to the women in the family. When a boy is selecting the line of work he purposes to follow, a word from the mother or sister often will be the deciding factor in his decision. These sketches are used by the Westinghouse company to give the man applying for work an idea of the conditions at the Westinghouse foundry. One feature of the foundry is the wash room and a view of it is included in the article on the molder.

The *Machine News* also is used to give one class of workmen an inkling of the work of another class. In this way the hooker-on is familiarized with the problems of the craneman and *vice versa*. Understanding the others' difficulties these two classes of workers are much more likely to work harmoniously together and to be able to help each other.

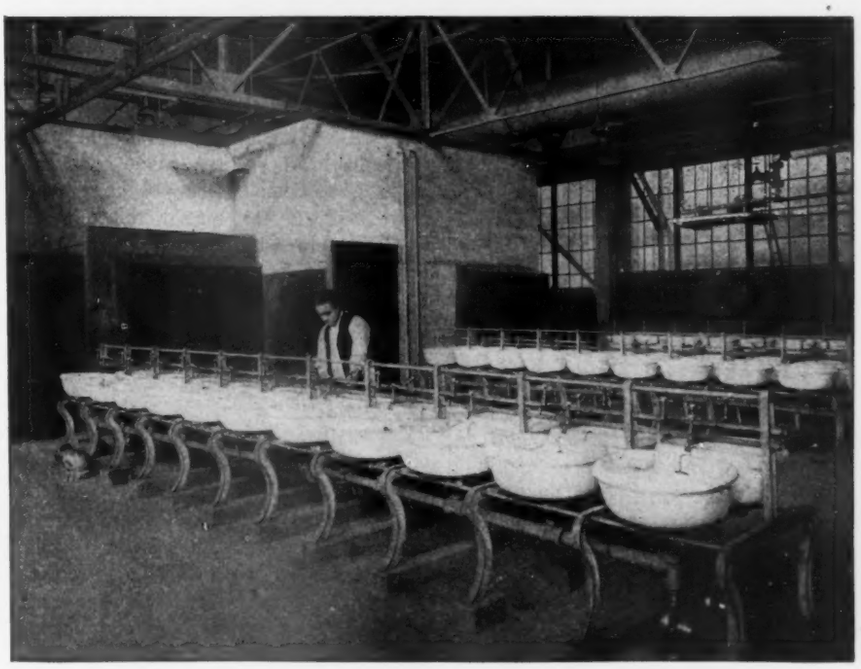


FIG. 2—A VIEW OF THE WASH ROOM APPEALS TO THE PROSPECTIVE EMPLOYE WHEN HE RECEIVES A COPY OF THE MAGAZINE

How and Why in Brass Founding

By Charles Vickers

Softening Yellow Brass

We have had trouble in using scrap brass for castings which require to be threaded, owing to the excessive hardness of the material, which many times is almost as hard as flint. We desire your suggestions as to what material may be put into ordinary yellow brass scrap to produce a soft mixture and still not cause loss of strength in the alloy.

The excessive hardness may be caused by the presence in the alloy of impurities such as tin or iron, and the first step should be to obtain an analysis of some of the hard castings to determine what is causing the hardness. If the hardness is caused by iron as is most likely, then it becomes a problem as to how the iron was introduced, and how it can be kept out. If the scrap is massive and the iron has been incorporated by previous melting operations, only one thing can be done, and that is to dilute the scrap by adding copper and zinc to reduce the iron to the point where it is harmless. If the scrap is in the form of turnings the iron exists free and can be removed largely by putting the turnings through a magnetic separating machine, or it can be removed by hand magnets. If tin is the hardening agent, the scrap must be diluted with new metal to reduce the tin content. The addition of 2 per cent lead will greatly improve the machining qualities of the alloy, without greatly impairing its strength. The only softening agent available for scrap brass is copper, and naturally this addition requires an addition of zinc also, otherwise, the alloy would cease to be a yellow brass. The following new alloy would save much trouble: Copper, 69 per cent; zinc, 26 per cent; lead, 3 per cent; tin, 2 per cent.

Babbitt Metal Formulas

We would like to know the composition of the commercial babbitt, and of the No. 1, 2, 3 and 4 babbitts.

Commercial or genuine babbitt is an alloy consisting of tin, 90 per cent; antimony, 7 per cent, and copper, 3 per cent. Nos. 1, 2, 3 and 4 babbitts may have any formula, as there are no standard babbitts so numbered. A rather antique set of alloys formerly known as Nos. 1, 2, 3 and 4 babbitts are the following: No. 1, lead, 68 per cent; antimony, 12 per cent; tin, 20 per cent. No. 2, lead, 73 per cent; tin, 12 per cent; antimony, 15 per cent. No. 3, lead, 77 per cent; tin, 5 per cent; antimony, 18 per cent. No. 4, lead, 80 per cent; antimony, 20 per cent.

The American Society for Testing Materials has suggested the following five alloys as able to fill all requirements: The alloys are: No. 1, tin, 83.33 per cent; antimony, 8.33 per cent; copper, 8.33 per cent. No. 2, tin, 89 per cent; antimony, 7 per cent; copper, 4 per cent. No. 3, tin, 50 per cent; antimony, 15 per cent; copper, 2 per cent; lead, 33 per cent. No. 4, tin, 5 per cent; antimony, 15 per cent; lead, 80 per cent. No. 5, antimony, 10 per cent; lead, 90 per cent.

Making High-pressure Castings for Brass

We wish to furnish castings for oxy-acetylene tanks and would like to obtain the formula for a mixture suitable for the purpose. The castings are subject to a pressure of one thousand to fifteen hundred pounds each, therefore, a good mixture is required. We have made castings for heavy pressure, of an alloy of copper 88 per cent; tin, 10 per cent; zinc, 2 per cent, but such castings machine slowly and it is necessary for the welding outfit castings to machine easily. What is wanted, therefore, is a dense, strong alloy easily machinable.

Castings of the nature described are generally made of an alloy consisting of copper, 54 per cent; zinc, 44 per cent; lead, 2 per cent. The alloy is first cast approximately to shape in metal or sand molds, and these castings are then heated to 1500 degrees Fahr. and are subjected to a squeezing or pressing force in dies, operated on much the same principle as drop forging dies. This operation produces a highly finished casting, dense in structure, which on account of the lead content, machines quite easily.

If ordinary sand castings are acceptable the following alloy will be suitable. Copper, 89 per cent; tin, 6.5 per cent; zinc, 2 per cent; lead, 1.5 per cent; nickel, 1.0 per cent. Melt the copper and the nickel together, add the white metals, stir thoroughly and pour at a medium temperature with a heavy gate.

Damp Sand Molds Harmful to Aluminum

We have lately experienced considerable trouble in making aluminum castings. The difficulty is due to porosity. We are using the same sand as for brass and bronze, and new sand is added each day. Is it possible for this trouble to be caused by using the same sand previously used for brass? If this is so, what kind of sand would it be best to use?

The fact that the sand has been used for brass before it was used for molds for aluminum has nothing whatever to do with the aluminum being porous. Aluminum molds are being made in alternation with brass and bronze all the time and no trouble has ever arisen that could be traced to this practice. A good, open sand should be used for aluminum. It should not be worked damp, but should be a little the other way, if anything. The temperature at which the aluminum is poured into the molds is the important consideration. If the castings are thin, ⅛ inch to ¼, the aluminum must be kept under 1350 degrees Fahr., otherwise, there is likely to be porosity and a very high cracking loss. Castings of heavy section should be poured as cool as possible, which temperature will range from 1200 to 1250 degrees Fahr. A pyrometer should be used to determine the temperature of the metal.

Allow the aluminum to cool before it is poured into the molds. If it is taken from the furnace hot, allow it to cool on the floor before pouring. It is always advisable not to overheat aluminum in the furnace. When aluminum is poured hot into a mold of damp sand it can be observed to simmer where it comes in contact with the sand. This results in the production of steam which is absorbed and retained by the metal, making fine holes; or the steam is decomposed into hydrogen and oxygen and the oxygen unites with the aluminum to form a solid aluminum oxide and the hydrogen diffuses through the mass of metal. The latter appears probable, as additions of selenium and tellurium, appear to assist the elimination of the fine holes. Watch the pouring temperature carefully, and pour as cool as possible to overcome the trouble.

THE FOUNDRY DATA SHEET, JUNE 1, 1920

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

IRON AND STEEL ETCHING SOLUTIONS

By Roy S. Kerns

Table Giving Etching Solutions for Iron and Steel With Their Chemical Compositions

ETCHING REAGENT	COMPOSITION	PROPOSED BY	USED FOR SHOWING	REMARKS
10% Nitric acid	10% Nitric acid, HNO_3 90% Alcohol, C_2H_6O	Sauveur	General structure of iron and steel	
Picric acid	5 gms. Picric acid, $C_2H_3(NO_2)_3OH$ 95 cc. Alcohol, C_2H_6O	Igevsky	General structure of iron and steel	Bottle should be well stoppered
Nitric acid	Nitric acid, HNO_3 concentrated	Sauveur	General structure of iron and steel	1.42 specific gravity
Sodium picrate	2 gms. Sodium picrate, $Na\ C_6H_2(NO_2)_3$ 24.5 gms. Sodium hydrate NaOH 73.5 cc. water	Kourbatoff	Cementite	Solution to be boiling
Steads reagent	10 gms. Cupric chloride, $CuCl_2$ 40 gms. magnesium chloride, MgCl 20 cc. Hydrochloric acid, HCl Alcohol, C_2H_6O, to make 1000 cc.	Stead	Phosphorus	Salts dissolved in hot water, and alcohol, added to make 1000 cc.
Heat tint	Molten bath of tinmans solder	Stead	Phosphorus, ferrous sulphide, manganese sulphide	
Silk printing	10 gms. Mercuric chloride, $HgCl_2$ 20 cc. water 100 cc. Hydrochloric acid, HCl	Heyn and Bauer	Sulphur	Solution Impregnated on strips of silk
Acid solution of lead, mercury or cadmium	Solution acidified with Hydrochloric acid or Nitric acid, HCl or HNO_3	Law	Sulphur	Mixed with gelatine
Ethyl alcohol	Alcohol, C_2H_6O, with 1% solution of organic acid (picric)	Rohl	Ferrous sulphide, Manganese sulphide	
10% alcoholic solution of nitric acid	90 cc. Alcohol, C_2H_6O 10 cc. Nitric acid, HNO_3	Sauveur	Wrought iron (Ferrite grains)	
5% alcoholic solution of picric acid	5 cc. Picric acid, $C_6H_2(NO_2)_3OH$ 95 cc. Alcohol, C_2H_6O	Sauveur	Wrought iron (Ferrite grains)	
Bitartrate of potassium	Bitartrate of potassium, $KHC_4H_4O_6$	Le Chatelier	Ferrite	
Soda and lead nitrate	Soda, 50% Lead nitrate, 10%	Le Chatelier	Cementite and Pearlite	
Hydrochloric acid and cupric chloride	10% gaseous Hydrochloric acid, HCl 5% $CUCl_2$, Cupric chloride	Le Chatelier	Annealed steels martensite, austenite, troostite, sorbite.	
Alcohol and acid solution in acetic anhydride	1 part $C_5H_{11}OH$, Amyl Alcohol 1 part C_2H_5OH, Ethyl Alcohol 1 part CH_3OH, Methyl Alcohol 1 part 4% HNO_3, Nitric acid in $C_2H_4O_2$, Acetic anhydride	Kourbatoff	Hardened steel.	Solution to be prepared just before use
Hydrochloric acid and alcohol	1 part Hydrochloric acid, HCl 99 parts Ethyl alcohol C_2H_6O	Heyn	Hardened steel.	
Hydrochloric acid and alcohol with electric current	1 part Hydrochloric acid, HCl 500 parts distilled water and electric current	Heyn	Hardened steel.	
10% HCl, hydrochloric acid in H_2O, water	10% Hydrochloric acid HCl 90% water.	Osmond	Martensite and austenite	
5% Metanitro-benzol sulphonic acid	Metanitrobenzol sulphonic acid, $C_6H_4NO_2HSO_3$	Benedicks	Martensito-austenitic steels	
Sulphurous acid	Saturated solution prepared and using 3 or 4% in water	Hilbert and Clover-Glauert	Non-pearlitic steels	

(*Concluded on Data Sheet No.* 336)

IRON AND STEEL ETCHING SOLUTIONS

By Roy S. Kerns

(*Concluded from Data Sheet No.* 335)

Table Giving Etching Solutions for Iron and Steel With Their Chemical Compositions

ETCHING REAGENT	COMPOSITION	PROPOSED BY	USED FOR SHOWING	REMARKS
Rosenhain and Haughton solution	30 gms. Ferric chloride, $FeCl_3$ 100 cc. concentrated Hydrochloric acid, HCl 1.0 gms. Cupric chloride, $CuCl_2$ 0.5 gms. Stannous chloride, $SnCl_2$ and water to make 1000 cc.	Rosenhain and Haughton	Ferrite and pearlite	
Heyns reagent	10 gms. Double Chloride of Copper and Ammonia, $CuCl_2NH_4Cl$ per 100 cc. water	Heyn	Neumann lines, etching figures and pits	
20% solution of sulphuric acid	20 cc. sulphuric acid, H_2SO_4 80 cc. Water	Stead	Etching pits in wrought iron	Cleaned in Nitric acid, HNO_3
Hydrogen peroxide and sodium hydrate	10 cc. Hydrogen peroxide H_2O_2 20 cc. 10% Sodium hydrate, NaOH, and water	Yatesevitch	High speed steel Free carbide	Preparation to be fresh every day
Cuprie ammonium chloride	10% water solution of double Chloride of Copper and Ammonia $CuCl,NH_4Cl, 6H_2O$	Heyn and Stead	Macrostructure. Etching pits in wrought iron	
20% solution nitric acid in water	20 cc. Nitric acid, NHO_3 80 cc. Water	Heyn and Stead	Macrostructure	
Tincture of iodine	Iodine, I, in Alcohol C_2H_6O	Osmond	General structure of iron and steel	
Steads solution	1.25 gms. Iodine, I, 1.25 gms. Potassium Iodide, KI 1.25 gms. Water Alcohol C_2H_6O, to make 100 cc.	Stead	General structure of iron and steel	
Martins and Heyns solution (1)	1 part Hydrochloric acid, HCl, sp. gr. 1.19 100 parts alcohol, C_2H_6O	Martin and Heyn	General structure of iron and steel	
Martins and Heyns solution (2)	1 part Hydrochloric acid, HCl, sp. gr. 1.19 500 parts Water with electric current	Martin and Heyn	General structure of iron and steel	
Heyns solution	12 grains, Cupric ammonium chloride, $CuCl_2\ NH_4Cl,\ 6H_2O$ 100 grains distilled water	Heyn	General structure of iron and steel	
Neutral sodium picrate solution	Neutral sodium picrate solution, $C_6H_2(NO_2)_3Na$	Matweieff	Distinguish between iron phosphide and cementite	Solution to be boiling
Saturated solution of picric acid	Picric acid, $C_6H_2(NO_2)_3OH$ alcohol C_2H_6O	Robin	Austenite and Martensite	
Electrolytic etching	Sheet lead for electrode 10 gms. Ammonium chloride, NH_4 Cl. or Ammonium sulphate $(NH_4)_2$ SO_4, per 100 cc. water, for electrolyte	Le Chatelier	General structure of iron and steel	4 or 5 volts with .001 to .01 amp. per sq. cm.
Hot etching	Calcium chloride, $CaCl_2$	Saniter	Steel structure	Molten to desired temperature
Hot etching	Gaseous Hydrochloric acid, HCl	Baykoff	Steel structure	
Nital	4% Nitric acid, HNO_3 96% Alcohol, C_2H_6O	Northrup and Knight	General structure of iron and steel	

Note—This sheet may cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Electrical Melting of Alloys—VII

Success of Resistance Furnaces Depends Upon Refractories for Roof and Resistor Container Which Withstand High Heat—New Designs Being Developed to Mitigate This Effect

BY H. W. GILLETT

IT HAS been shown in the previous articles that localized heating and the high temperature of the source of heat of direct-arc and stationary indirect-arc furnaces make them inapplicable to melting brass high in zinc, and that by rocking an indirect-arc furnace the local overheating may be avoided. It also is posible to avoid, or reduce local overheating by using a shallow hearth to which heat is sent from a larger source than an arc, and from an origin at a lower temperature.

Various furnaces in which a large carbon resistor is placed over the hearth have been tried or suggested. The Hoskins-type furnace with a pack of resistor plates over the hearth was tested by the bureau of mines in 200 and 300 pound sizes. In 9-hour operation 2500 pounds of yellow brass were melted per day with 400 kilowatt hours per ton. Red brass required 500 kilowatt hours per ton to melt it. On 24-hour operation yellow brass would need about 275 and red brass 335 kilowatt hours per ton. The metal loss was 0.7 per cent on yellow brass and there was no trouble from local overheating. However, structural difficulties would be met in making this furnace in sizes large enough to be of much value. Fig. 3 shows the Hoskins overhead resistor furnace.

Zig Zag Resistor

The Thomson* is another overhead resistor furnace. It has a solid carbon resistor located over the bath. This resistor is slotted to give a zig-zag shape and increase its resistance, as may be noted in Fig. 2. A gyratory motion like that of the later moving Stassano furnaces is given to the Thomson furnace. This furnace was advertised early in 1919 for use on brass. A price of $11,800.00 for a 1000-pound furnace complete with transformer was quoted at that time. It does not seem to have been advertised since. The furnace was claimed to be capable of melting yellow brass, in 24-hour operation, at 250 kilowatt hours per ton. No detailed tests have been cited and no commercial installations appear to have been made. This type could be made in useful sizes. Its value would depend largely on the length of life of the resistor and the ease with which a new one could be put into the hot furnace to replace the old one. Mr. Thompson has recently informed the writer that the original *nonburning* resistor, having a silicon carbide coating, was a *disappointment*, as it failed under really severe tests, but that the difficulty has been overcome by another method on which patents have been allowed but are not yet issued.

Without the record of actual tests—and none have yet been published or given out—it is impossible to tell whether the life of the resistor would be long enough, or whether the gyratory motion would afford satisfactory mixing of the metal. This type has possibilities and it is to be regretted that its development has so far been slow. On account of the gyratory motion it would be difficult to make this type tilting instead of tapping. The solid, slotted resistor, or a tubular resistor of the same type, could be mounted in a cylindrical furnace, rotating or oscillating to mix the charge, and it is understood that this form also is to be developed for brass. In such a form automatic charging would be impractical and hand charging would have to be carefully done to avoid breaking the resistor which could not be withdrawn when

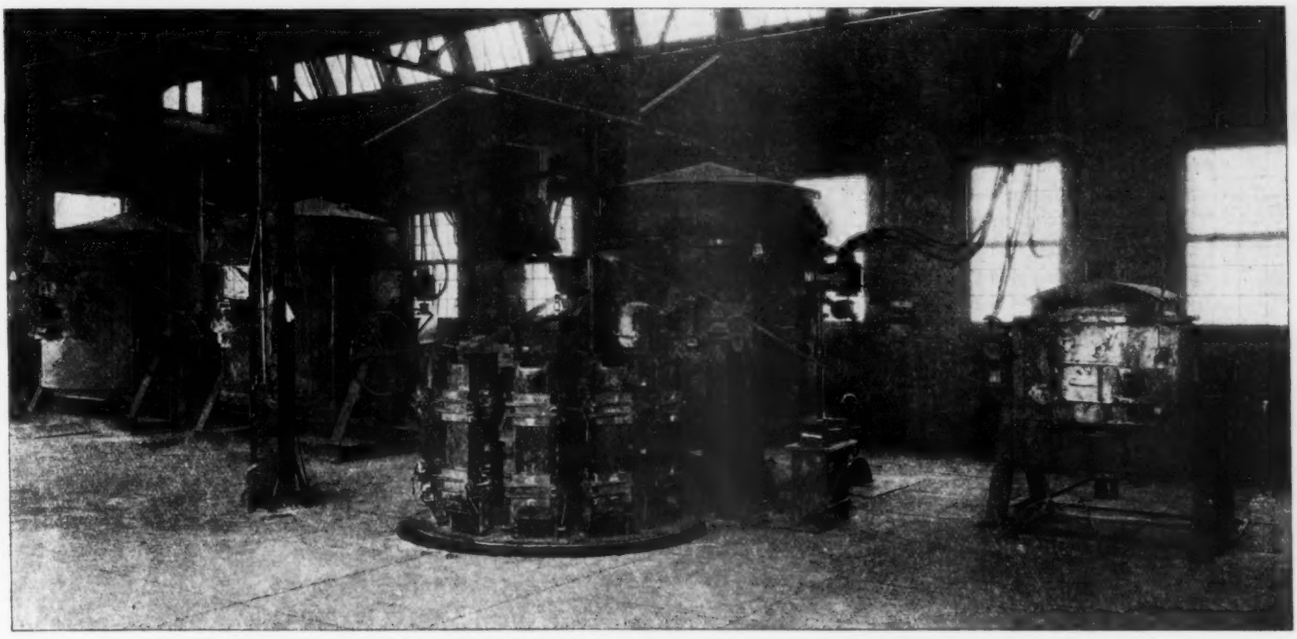


FIG. 1—A BATTERY OF THREE NOSE-TILTING TYPE OF STANDARD 105-KILOWATT BAILEY FURNACES WITH SPECIAL CASTING TABLE FOR MAKING INGOTS

*Thomson, J., U. S. Patents, 1321682 950880; 1318030; 1318031.
Fitzgerald, F. A. J., U. S. Patents, 950878.

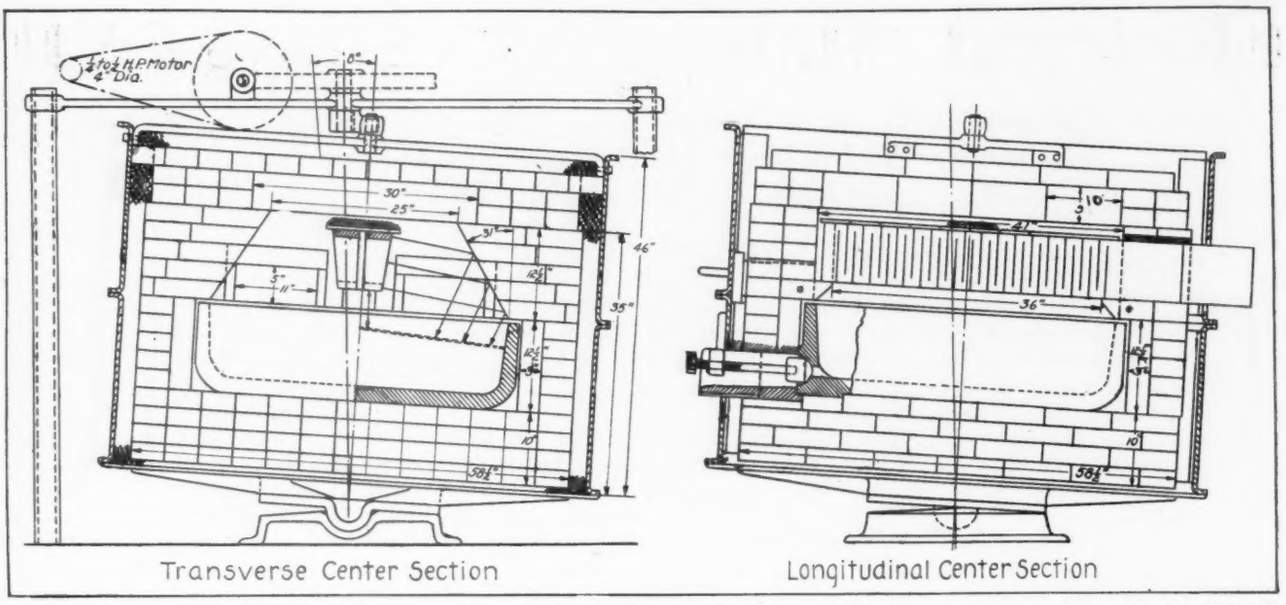


FIG. 2—THOMSON ZIG ZAG RESISTOR GYRATORY FURNACE—TO THE LEFT, THE TRANSVERSE CENTER SECTION—TO THE RIGHT, THE LONGITUDINAL CENTER SECTION

charging, as can the electrodes of the rocking-type furnace. On the other hand, such a furnace would be made with two resistors, so as to use two-phase power from three-phase by the Scott connection and thus give a balanced load, which could be done readily The electric-brass furnace using heat radiated from a large source at lower than arc temperature which so far has the widest commercial use is the Baily* made by the Electric Furnace Co., Alliance, Ohio. This is a single-phase, granular resistor, hearth-type furnace, and is the fruit of Mr. Baily's long experience with granular resistor type of furnaces.

The first Baily brass furnace of this type to continue regular commercial service on brass or bronze was installed at the plant of the Lumen Bearing Co., Buffalo, in 1917. A similar furnace had been installed at the same plant the previous year for handling the low-melting aluminum alloy. This was the second commercially successful electric brass furnace in America, the first being the Ajax-Wyatt induction furnace at the Ajax Metal Co., Philadelphia, which was producing brass commercially in January, 1916. The Baily furnace is shown in Figs. 1, 4, 5, 6, 7 and 8. Fig. 4 shows how the electrodes *A*, make contact with

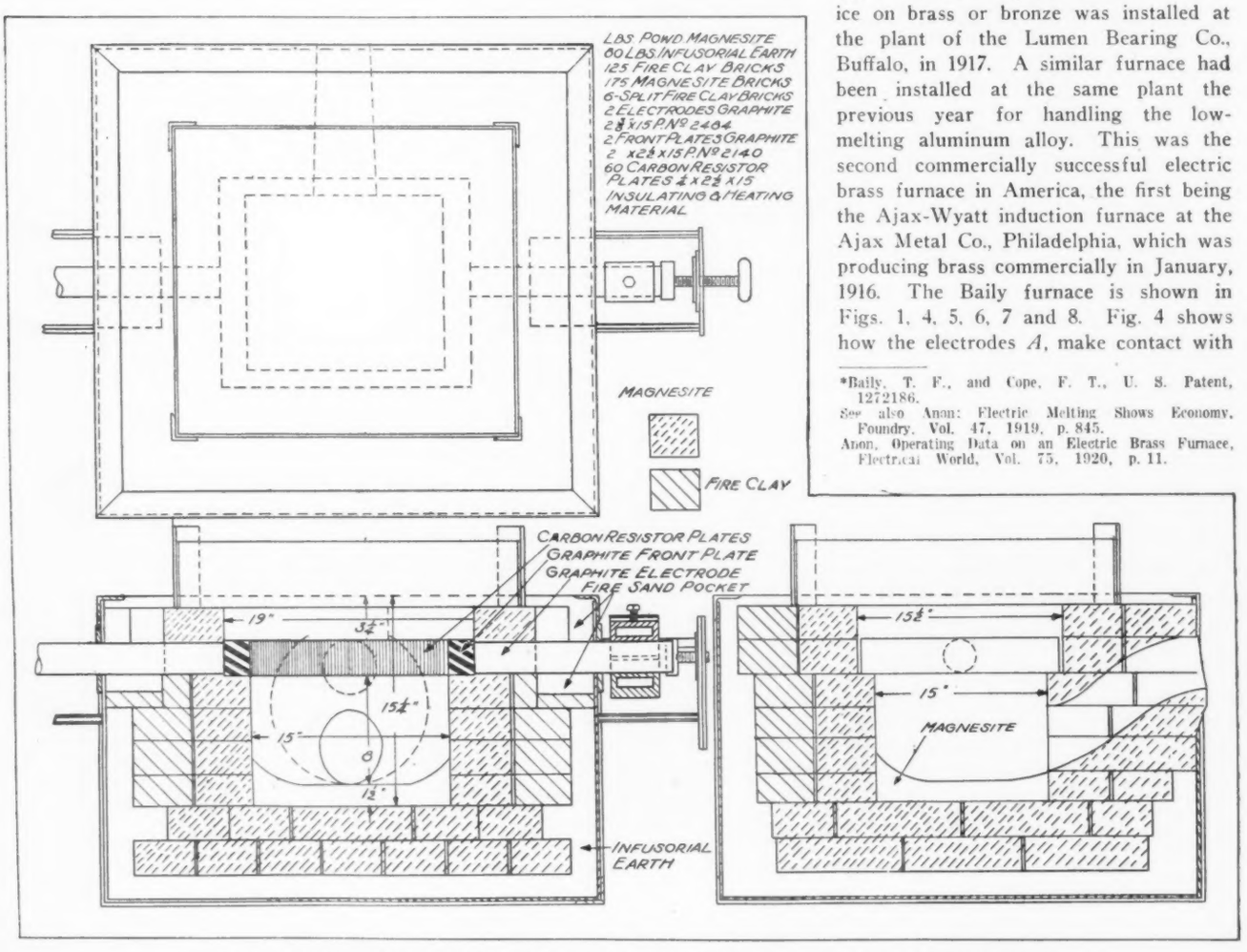


FIG. 3—HOSKINS OVERHEAD RESISTOR TYPE FURNACE—THIS FURNACE IS BUILT ONLY IN SMALL UNITS

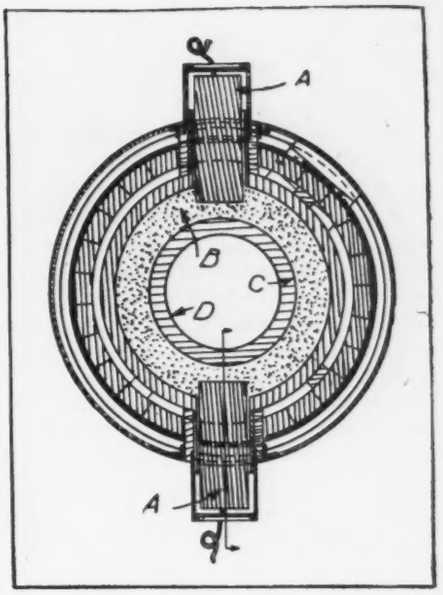
*Baily, T. F., and Cope, F. T., U. S. Patent, 1272186.
See also Anon: Electric Melting Shows Economy, Foundry, Vol. 47, 1919, p. 845.
Anon, Operating Data on an Electric Brass Furnace, Electrical World, Vol. 75, 1920, p. 11.

the granular resistor *B* held in the resistor trough *C*.

As was pointed out under crucible furnaces, a granular resistor has a tendency to develop hot-spots. To prevent this, the resistor must be made of generous dimensions which avoids too high a current density. A granular resistor has to be held in some kind of a container to keep it from running out. Since the interior of the resistor operates at 1800 to 2000 degrees Cent. the container, or resistor trough, must be made of very refractory material, carborundum being practically the only refractory available.

Carborundum decomposes at 2200 degrees Cent., so it is necessary to prevent it from reaching that temperature. According to Hirsch* and Thornton** a granular resistor inside a carborundum trough cannot be run hot enough in a forging furnace to heat steel at a sufficiently rapid rate, to more than 1000 degrees Cent. without promptly injuring the carborundum container. Baily heats brass above 1000 degrees Cent. without undue injury to the resistor trough by taking two precautions; first, he makes the resistor large and uses a low rate of power input in order to prevent overheating of the resistor; second, he provides for all the radiation possible from the resistor trough by setting it up on piers, not resting it on a continuous refractory floor, and by leaving an air space between the trough and the sidewalls. These arrangements check overheating. The necessary size of the resistor trough and its location, out of contact with the walls, fixes the size of the furnace. The power input is fixed, not in relation to the size of the furnace, but by the limit that the resistor trough can stand with safety. The furnace, as is illustrated in Figs. 6 and 7, is huge and the waste space consequently is great compared to the volume of the charge. The standard 105 kilowatt furnace has a shell some 6 feet in diameter by 7 feet high and is rated at 1500 pounds capacity. The average charge is probably near 1200 pounds, though a 2-ton charge has been melted in this furnace.

The low power input and the large wall area to leak heat, both tend toward a low thermal efficiency. This is accepted as a necessary evil in this type furnace in order to attain sufficient trough life and insure reliability. The large wall volume gives the furnace a huge heat storage capacity and makes it sluggish. It cannot be brought up to temperature rapidly after being cooled, because there is so much brickwork to heat. Therefore, it must be heated while



VIEW OF BAILEY RESISTANCE TYPE FURNACE SHOWING ELECTRODE CONNECTION

TABLE 1

Rate of Production and Power Consumption in 105 Kilowatt Bailey Furnaces

Alloy	Firm	Figures based on	Hours furnace pre-heated per day	Hours furnace used per day in actual melting	Weight charged lbs.	Output per day tons	K.W.H. per ton	Remarks
Yellow Brass	Baltimore Copper Smelting and Rolling Company	Average operation	15	9	800	2	650	Metal poured at 1025° C.
Yellow Brass	McRae	Best operation	3½	9	1500	3¾	425	
Yellow Brass	Roberts	Best operation			not stated	not stated	264	
	Michigan Smelt. and Ref. Co.		0	24				
60/40	U. S. Copper Products Company	Average operation	0	24	...	8	310	
Brass	Hays Mfg.	1 month						
20% Zinc	Company	70 tons	2½	9½	1500	3	572	
Red Brass	Capital Brass Co.	Best operation	0	16	1500	6	not stated	Output given is maximum.
Leaded Bronze	Buick Motor Car Company	Test Operation	4½	10½	1200	3½	413	
Leaded Bronze	Nolte Brass Company	Average operation	4	16	1500	4	500 to 575	
Bronze	Lumen Bearing Company	Average operation	14	10	800	2¾	600	Metal poured at 1150° C.
Red Brass	Penberthy Injector Co.	Average operation	3	20	1500	4½	550	Up to 6½ tons have been gotten out in two ten-hour shifts.

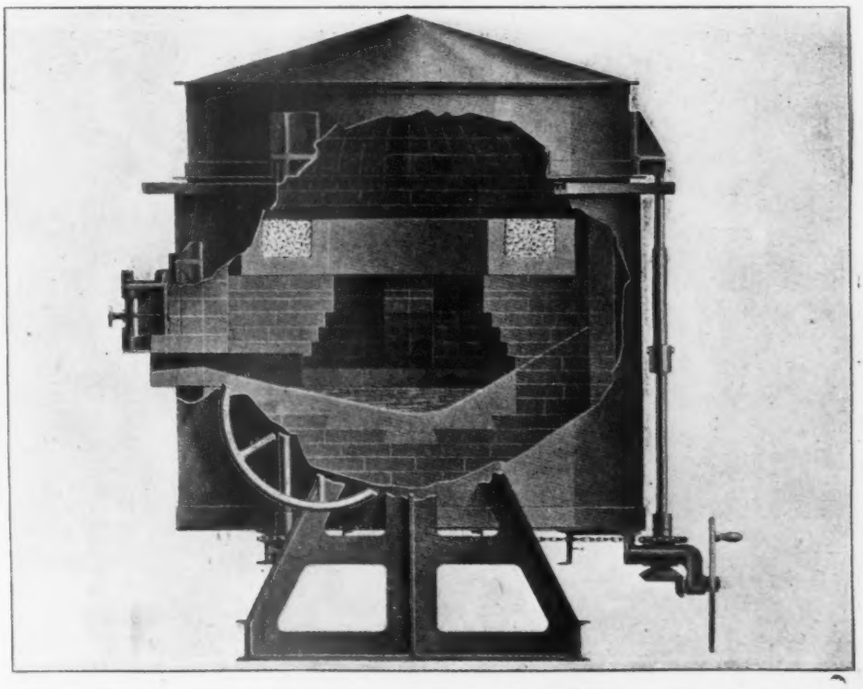


FIG. 5—VIEW OF THE BAILEY FURNACE SHOWING THE POSITION OF THE TROUGH WHICH CONTAINS THE GRANLUAR RESISTOR

*Hirsch, A., Electric Furnaces for Heating Steel, Jour. Ind. Eng. Chem., Vol. 6, 1914, p. 533.

**Thornton, F., Jr., A Resistance Furnace, Trans. Am. Electrochem. Soc., Vol. 32, 1919, p. 257.

empty for several hours in the early morning, when it is used on only one shift per day. This is necessary in order to replace the heat lost at night, and to have the furnace ready for charging the metal when the shop opens.

The furnace is thus handicapped by its own inherent requirements of design, when used on only 8 to 10-hour operation, but it will make a far better showing on 16 or 24-hour operation. On account of the sluggishness of the furnace, temperature control is not sharp. Miller* states that something like 15 minutes are required for the furnace to begin to respond to a change in power input.

The furnace takes single-phase power at 60 to 100 volts, 75 volts on the average. When the furnace is hot 1400 amperes of current is used. The furnace has practically a 100 per cent power factor. Most central stations consider it an acceptable load. The power input is regulated by switching from one tap to another of the furnace transformer so as to vary the voltage across the electrodes.

The current is steady and so there are no surges, but the current and power input tend to drift up or down depending on whether the resistor is heating up a little or cooling off a little. For this reason the furnace cannot be left entirely to itself, lest it start to draw too much or too little power. However, it requires little attention.

Automatic control can be applied to resistance furnaces** but it is highly doubtful if the large expense of the rather complex control system would be justified on 100 kilowatt furnaces. On the 1100-kilowatt Norwegian zinc smelting furnaces, for which an automatic control system was designed, its use is doubtless thoroughly justified.

The operation of the Baily furnace is extremely simple, the main precaution required being that the resistor must not be overheated. To keep some check on this, a pyrometer is usually installed in the roof and care taken not to let this get above a predetermined maximum. The readings of this pyrometer of course show nothing at all as to the temperature of the charge. The lining and roof are usually of corundite brick, backed up by loose infusorial earth. The tamped-in hearth is often made of carborundum firesand.

The life of the brick lining is long, since the limiting factor in the rate of energy input is not what the lining, but what the resistor trough, will stand. Some of the transformers supplied with early furnaces heated up badly on their rated 105 kilowatt load, but later ones will stand up to 120 kilowatts. The earlier resistor troughs formed in the furnace by the users, often failed quickly. The makers now supply trough sections, molded and baked like bricks, that are more reliable. The troughs are still the weakest link in the chain, and operation at any rate that is safe for them is usually safe for the transformer and lining. The electrodes, which are not water-cooled have a satisfactory life. They are usually renewed when a new trough is installed.

The length of life of the resistor troughs has been found different by various users. Some report that the resistor fails after 125 tons are melted, while others say that the resistor will last longer. Resistors have been re-

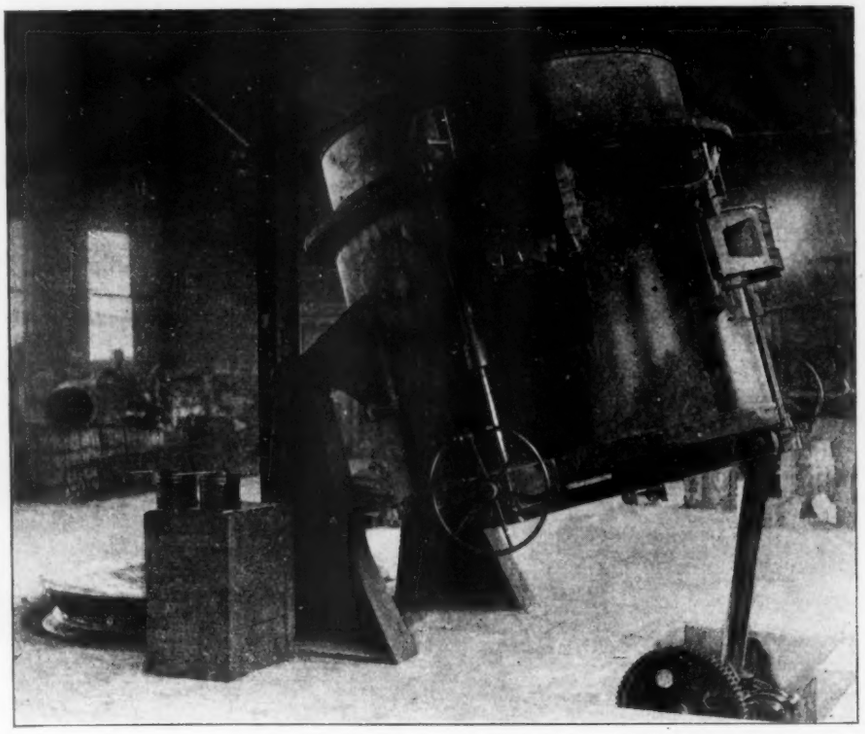


FIG. 5—BAILEY RESISTANCE FURNACE OF THE NOSE-TILTING TYPE, GIVING A VIEW OF THE TILTING MECHANISM

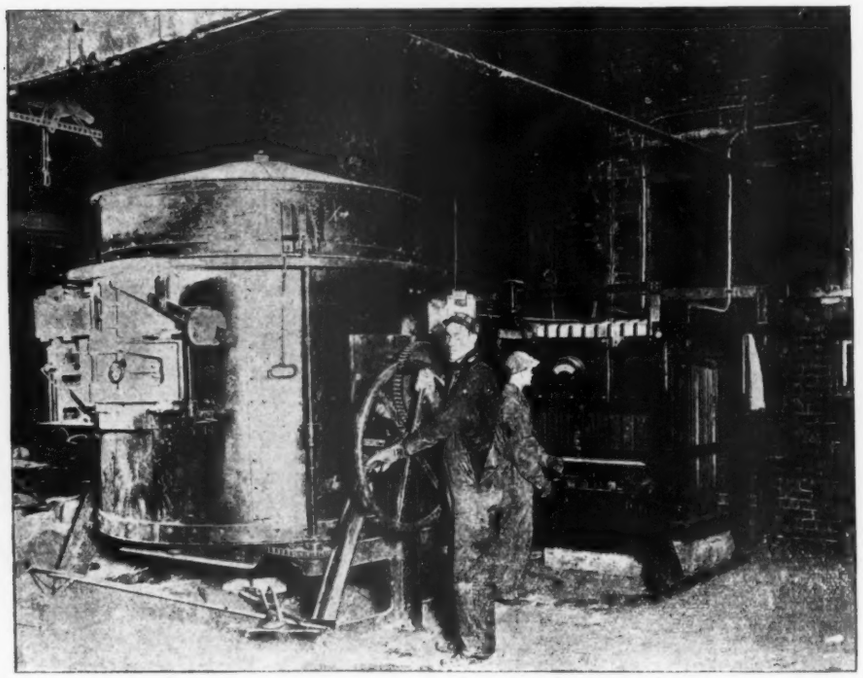


FIG. 6—BAILEY RESISTANCE TYPE FURNACE—THE AMOUNT OF CURRENT ENTERING THE FURNACE IS CONTROLLED BY THE SWITCH TO THE RIGHT

*Miller, D. D., The Electric Furnaces as a Medium for Heating Non-Ferrous Metals, Jour. Am. Inst. Metals, Vol. 11, 1917, p. 285.

**Lehr, E., U. S. Patent, 1320071.
Short, P. B., Step Induction Regulator for Electric Furnaces, Trans. Am. Electrochem. Soc., Vol. 37, 1920, p. 35.

ported to last for the melting of 500 tons of metal. Replacing the trough costs about $100.00, and replacing a lining about $50.00. The granular resistor gradually burns away, and must be replenished from time to time. This is usually done every Sunday, or every second Sunday. Either chip graphite or crushed electrode carbon, low in ash, is used for the resistor. These substances are used instead of crushed coke to avoid difficulties due to the accumulation of ash. From 5 to 10 pounds of resistor is consumed per day.

The metal losses in the Baily furnace are low, on yellow as well as on red brass, since the furnace can be tightly closed. The following figures, all from actual tests, appear representative.

Alloy	Net loss % in different tests
Yellow	1.39, 0.56, 0.30, 1.30, 0.81. Average under 1%.
60/40	1.5%—average operation on heavy scrap and new metal.
Brass—20% zinc	0.75—coke fire loss 3%.
Leaded bronze	0.76—another plant gives average operating loss as 0.75%.
Phosphor bronze	0.68—0.24%.

The quality of the product is found either "the same as" or "as good as, and with less variation in quality than" metal from crucibles, according to users of the furnace. There seems to be but one point on which its metallurgical qualification falls below that of some other types, that is, there is automatic stirring and if careful hand-stirring is neglected the product may vary in analysis. Baily* gives analyses on 30 sets of first and last bars from 750-pound heats of 70/30 brass. In these tests the copper in the last bars averaged 0.70 per cent higher than in the first bars. Eight heats showed over 1 per cent and one heat over 2 per cent variation between the first and last bars cast from the same heat. The rolling mill that formerly used the furnace in which these tests were made has stopped making brass, but the statement was made that while the furnace was still in operation the metal from the same heat, even after careful stirring, showed differences of over 2 per cent in the copper contents.

Few Baily furnaces are used in rolling mill work. Sand-casting plants appear able to secure sufficient uniformity on the alloys they melt in the Baily by careful stirring.

The rate of production and the power consumption in Baily 105 kilowatt furnaces are shown in Table I. Depending on the alloys melted, and on the way the furnace is handled, it appears that, on 8 to 10 hours of actual melting, the furnace will use around 450 to 650; on 16-hour melting, 400 to 550, and on steady 24 hour melting, 265 to 335, kilowatt hours per ton. That is, this furnace, like all others, gives widely different results on different schedules of operation and with varying degree of care. For example, a blanket of slag on the metal shows up the rate of heat absorption and will cut down production if not skimmed off as soon as the charge is melted. Oily yellow borings give much trouble as they require continuous hand-rabbling.

*Baily, T. F., Resistance Type Furnace for Melting Brass, Trans. Am. Electrochem. Soc., Vol. 32, 1917, p. 155.

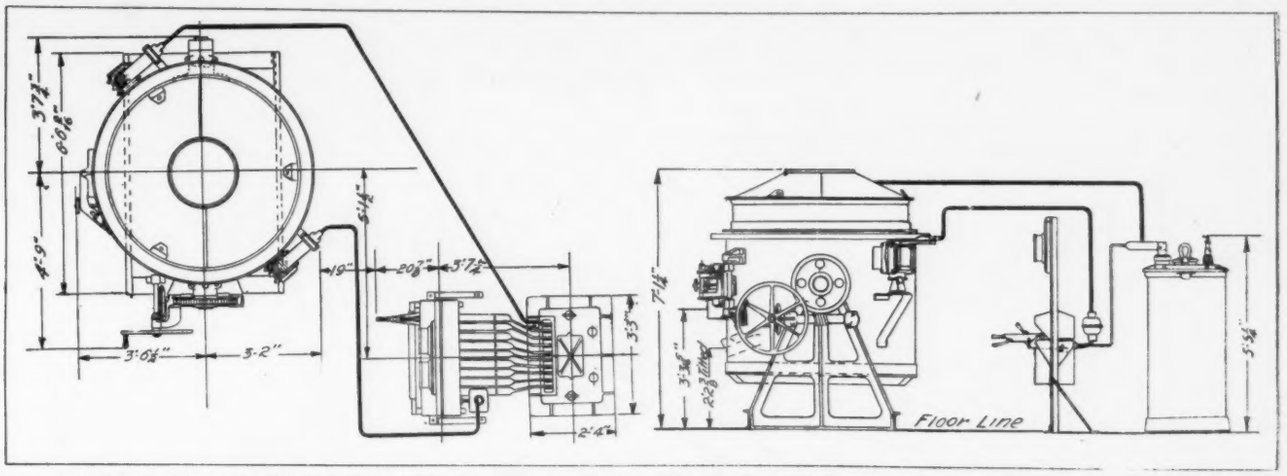


FIG. 8—LAYOUT OF THE 50-KILOWATT BAILEY FURNACE—THIS IS ONE OF THE NEWEST DESIGNS OF THIS TYPE FURNACE AND NO OPERATING DATA IS AVAILABLE

Several Advantages

Although its low rate of production and low thermal efficiency make it far less useful for single-shift operation than for 16 to 24-hour operation, especially where power is high, its reliability, simplicity of operation, adaptability to alloys both low and high in zinc, and its avoidance of crucible cost and decrease in labor cost, together with its good results in reducing metal losses, have made it a commercial success. It is one solution of the problem of finding an electric brass furnace applicable to both brass and bronze, which can show savings in total melting costs over fuel-fired furnaces in most plants.

The standard 1500-pound, 105 kilowatt trunnion-type furnace, completely equipped, was priced, in April, 1920, at about $9400. The smaller sizes, 50 kilowatt and 75 kilowatt were priced at about $5000 and $6500 respectively.

Besides the standard 105 kilowatt Baily furnace, built in trunnion and nose-tilting types as illustrated in Figs. 6 and 7, a larger 300-kilowatt furnace of the same form has been designed, but none of these has been installed. A smaller 50-kilowatt rectangular furnace was recently designed, but the resistor trough, which was directly over the hearth and was supported only at the ends, gave so much trouble and had so short a life that all these 50-kilowatt rectangular furnaces that had been sent out were recalled. They are to be replaced by furnaces with the regular circular form of trough, similar to that in the 105-kilowatt standard size. No data is as yet available on the performance of 50 and 75-kilowatt Baily brass furnaces. The design of the 50-kilowatt size is illustrated in Fig. 8.

A large, 10-ton tapping-type brass furnace, similar in design to the Baily heat-treating furnace, to the 500 kilowatt furnace formerly used by the United States Aluminum Co. for melting aluminum* and to the 1000 kilowatt furnace formerly used by the Anaconda Copper Mining Co. for melting zinc cathodes**, has also been designed but none has been built.

Recent advices from the users of the large Baily tapping furnaces for zinc and for aluminum state that the use of both has been abandoned. The utility of extremely large and extremely small fur-

*See Miller, D. D., The Remelting of Aluminum Pig in the Electric Furnace, Chem. and Met. Eng., Vol. 19, 1918, p. 251.

**See Baily, T. F., Resistance Type Electric Furnace for Melting Non-Ferrous Metals, Trans. Am. Inst. Chem. Eng., June, 1919 meeting.

naces of this type is open to question, but the standard size has proved of value.

Since the low efficiency of the Baily furnace is largely due to the low power input and to the large space required to give free radiation to the trough, a suggestion by Thomson* aimed to protect the bottom of the trough, and thus to allow the use of a higher rate of power input, is of interest. Instead of a complete granular resistor, the lower part of the resistor consists of a trapezoidal zig-zag solid-graphite resistor, with the wide base of the trapezoid at the bottom, so that the current density, and hence the heating, tends to be less at the bottom.

The remaining portion of the resistor is made up of granular material. Thomson also plans to tilt the resistor, or to arch the roof to prevent the radiated heat from being reflected directly back to the resistor. Incidentally, the writer would prefer to avoid having the metal level in the hearth above the resistor, as has been done, since any leakage of metal through the dividing wall into the resistor would have unpleasant results.

Theoretically, at least, Thomson's suggestion ought to be improvement upon furnace using granular material alone in the resistor. Whether it would or would not involve drawbacks outweighing its advantages will have to be told by trial.

**Collins has produced a type of furnace known as the General Electric furnace, in which the heat is generated over a large area at the sides of the furnace and reflected downward onto the bath by the roof, much as in the Baily furnace, but instead of limiting the power to 105 kilowatt on a 1500-pound furnace, he provides 400 kilowatts on a 1¼-ton furnace. The greatly increased rate of power input should give the furnace a better thermal efficiency than the Baily furnace. However, its design is not one of high inherent thermal efficiency due to the waste space and large surface area, and to the indirect manner in which the heat must pass from its source to the charge, by reflection from the roof. The furnace is shown in Figs. 10, 11 and 12.

The usual form of this furnace consists of a shallow hearth in the middle of a rectangular furnace shell, the side walls of the hearth separating it from the two heating troughs, one at each end. Each trough contains carbon blocks covered with granular graphite resistor. Four electrodes, each pair connected to one of the two current phases, are supported by masts on the ends of the furnace shell. They extend through the roof, each pair coming down into one of the resistor troughs and each electrode tip being surrounded by, but in poor contact with, the granular resistor. A series of tiny arcs are thus drawn from each electrode tip to the granular

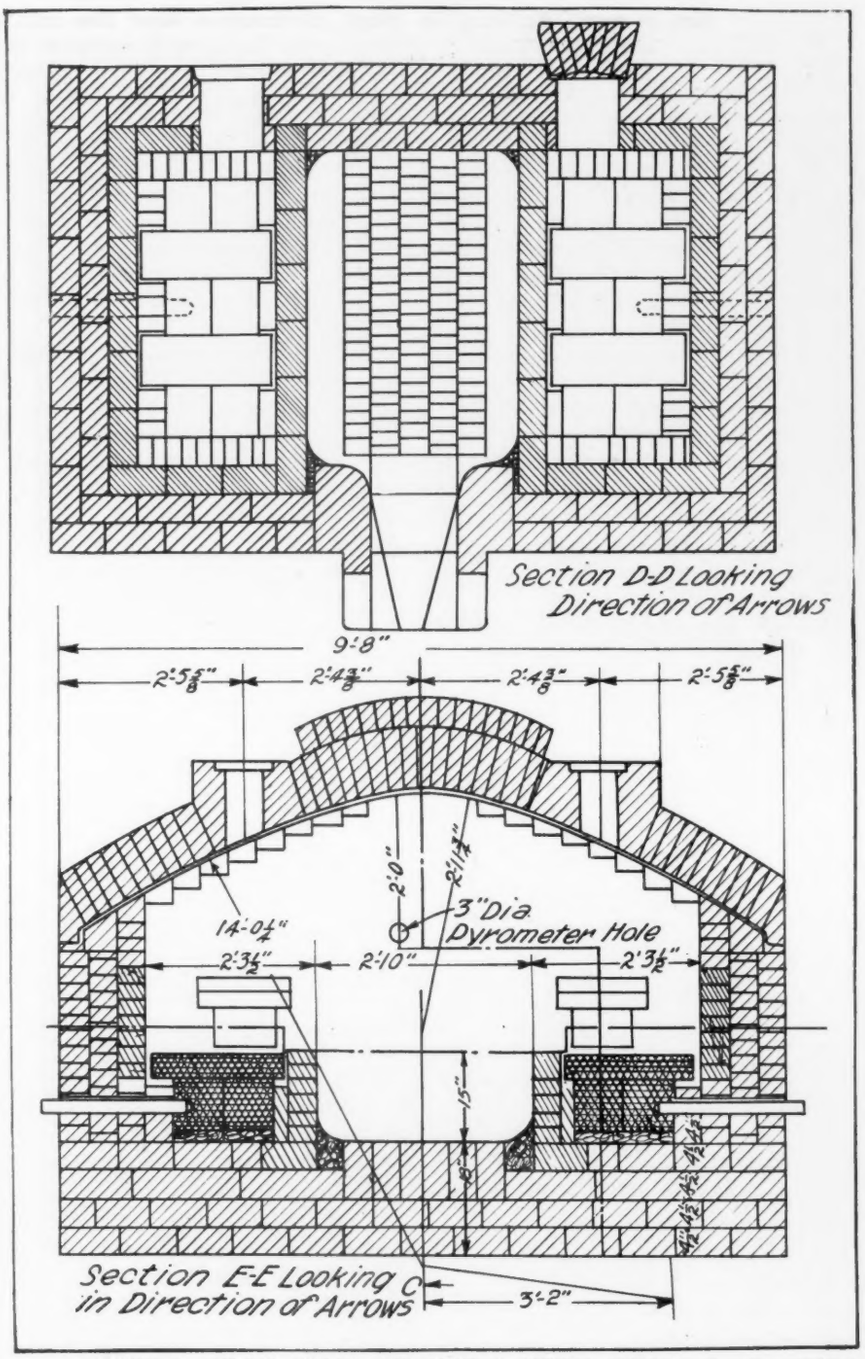


FIG. 9—HORIZONTAL SECTION (ABOVE) AND VERTICAL SECTION (BELOW) OF THE GENERAL ELECTRIC RESISTANCE TYPE FURNACE

*Thomson, J., U. S. Patent—allowed but not yet issued.

**See Valentine, J. R., U. S. Patent, 1242275.
Collins, E. F., U. S. Patent, 1271280.
Electric Furnace for Melting Non-Ferrous Metals and their Alloys.
Foundry, Vol. 47, 1919, p. 284, 329.
Jour. Cleve. Eng. Soc., Vol. 11, 1919, p. 293.
Metal Ind., Vol. 17, 1919, p. 221.
Chem. Met. Eng., Vol. 21, 1919, p. 673.

TABLE 2

Prices of General Electric Furnaces Obtaining April, 1920

Capacity inlbs.	K. W.	Price	Maker's statement of K.W.H. per ton 24-hour operation, on brass heated to 1100° C.	Production per hour claimed by makers on 24-hour operation	Size graphite electrodes	Maker's statement of K.W.H. per ton, 24-hour operation, on copper, heated to 1300°C.
3500	600	$20,000	250	3000 pounds	8" dia.	300
2500	400	17,000	250	2000 pounds	6" dia.	300
2000	300	16,000	275	1500 pounds	6" dia.	325
800	125	8,000	300	600 pounds	4" dia.	350

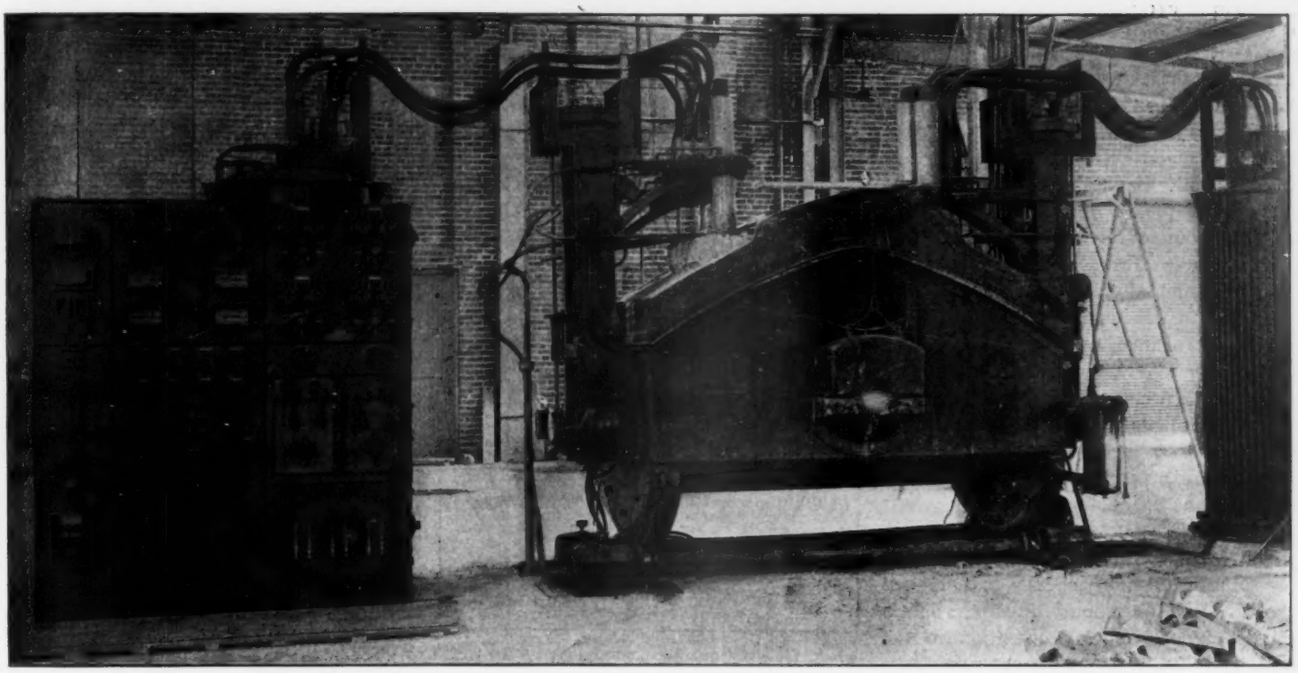


FIG. 10—FRONT VIEW OF THE GENERAL ELECTRIC BRASS MELTING FURNACE WITH AUTOMATIC CONTROL PANEL—THIS FURNACE IS RATED TO MELT 2250 POUNDS PER HOUR

material. Some heat is also generated by the passage of current through the granular resistor itself.

The original flat arch of the roof has been replaced by a deeper arch, and the sides of the furnace have been raised so as to bring the base of the arch further away from the heating troughs, in order to protect the roof. The electrodes are adjusted automatically, the only hand control needed being to set rheostat handles and throw switches or push buttons on the switchboard. Graphite electrodes 5 to 6 inches in diameter are used. The consumption of electrodes and crushed graphite is given as about five pounds per ton. The walls and roof in a furnace of such a design and so high a power input receive extremely severe punishment, so in the General Electric furnace the roof is the weakest point, and its life is rather short.

The big advantage of the General Electric furnace is that it takes multiphase power, two-phase from three-phase by the Scott connection, and has, by means of its automatic electrode control, freedom from surges and a steady load. Its power factor is nearly 100

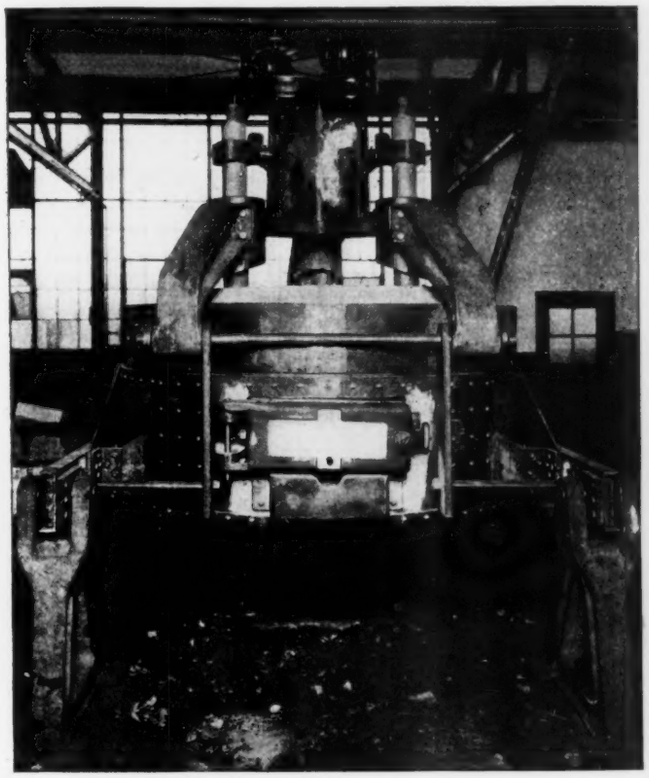


FIG. 11—REAR VIEW OF THE GENERAL ELECTRIC 600-POUND CAPACITY BRASS MELTING FURNACE, NOSE-TILTING TYPE FIG. 12—FRONT VIEW OF THE SAME FURNACE

per cent. From the point of view of the central station a furnace of such electrical characteristics would be perhaps the most desirable load of any electric brass furnace. Only a few commercial installation have been made, so it is difficult to check the claims of its makers as to its desirability from the foundry point of view.

This type of furnace has been operated on brass and aluminum at the General Electric Co., Schenectady, N. Y., since 1917. According to charts shown by Collins, the 2¼-ton furnace, operating on red brass, preheated empty for three hours before charging, and charged about half an hour before the regular 10-hour foundry day began, produced about 4 1/3 tons per day. Another chart shows that the power consumption, which is taken to be 300-kilowatt hours per ton on 24-hour operation, averaged about 350 kilowatt hours due to the delays encountered in regular operation in the foundry. This figure apparently does not include the power used in preheating, since the power consumption stated for *brass* in a table of melting costs is 400 kilowatt hours per ton on 10-hour operation. The power consumption claimed on 24-hour operation is 250 kilowatt hours per ton. In another table 350 kilowatt hours per ton with 10-hour operation, and 220 kilowatt hours per ton with 24-hour operation is claimed on yellow brass. Various metal loss figures, all fairly low, are given. The quality of metal, by physical test, is claimed to be superior to that from fuel-fired furnaces.

The first furnace of this type installed outside the General Electric plant was in 1918 at the Crane Co., Chicago. The

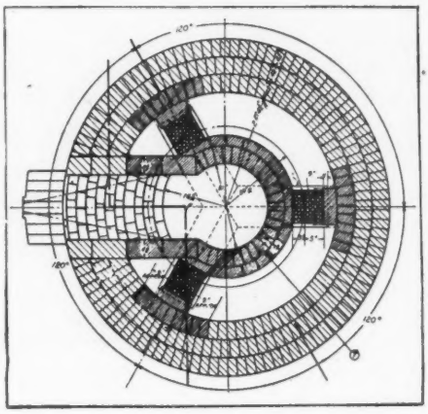


FIG. 14—SECTION OF THE NEW 800-POUND GENERAL ELECTRIC BRASS MELTING FURNACE

furnace was not out of the experimental stage and much trouble was experienced in selecting a refractory and a form for the roof that would give a reasonable life. Difficulty was also met in maintaining the carborundum wall between hearth and heating trough, as metal would leak through the wall, either getting into the trough and causing a shutdown, or, in some cases, picking up silicon and ruining the metal. In making cored valve bodies the percentage of the *leakers* was stated by the Crane Co. to be far above that from crucible metal. However, the General Electric Co. states that in tests at the Crane plant, made when a properly preheated ladle was used, the percentage of defective castings was the same from electric as from the crucible furnace metal. The furnace was finally rejected by the Crane Co. The metal losses on red brass were said to be about the same as in crucibles and the power consumption under favorable conditions, somewhere around the 400 kilowatt hours per ton predicted by the makers of the furnace for the 10-hour operating schedule on which the furnace was run, under the conditions at that plant.

It is regretable that the cause for the failure of the furnace to operate satisfactorily cannot be thorough explained, as the rejection of this furnace has been in measure a hindrance to the acceptance of all other electric brass furnaces, but the contract between the General Electric Co. and the Crane Co. prevents the latter from giving out quantitative data on the operation of the furnace.

Two General Electric furnaces* are installed at the McNab and Harlin

*See Vickers, C., What is Aterite? Foundry, Vol. 48, 1920, p. 70.

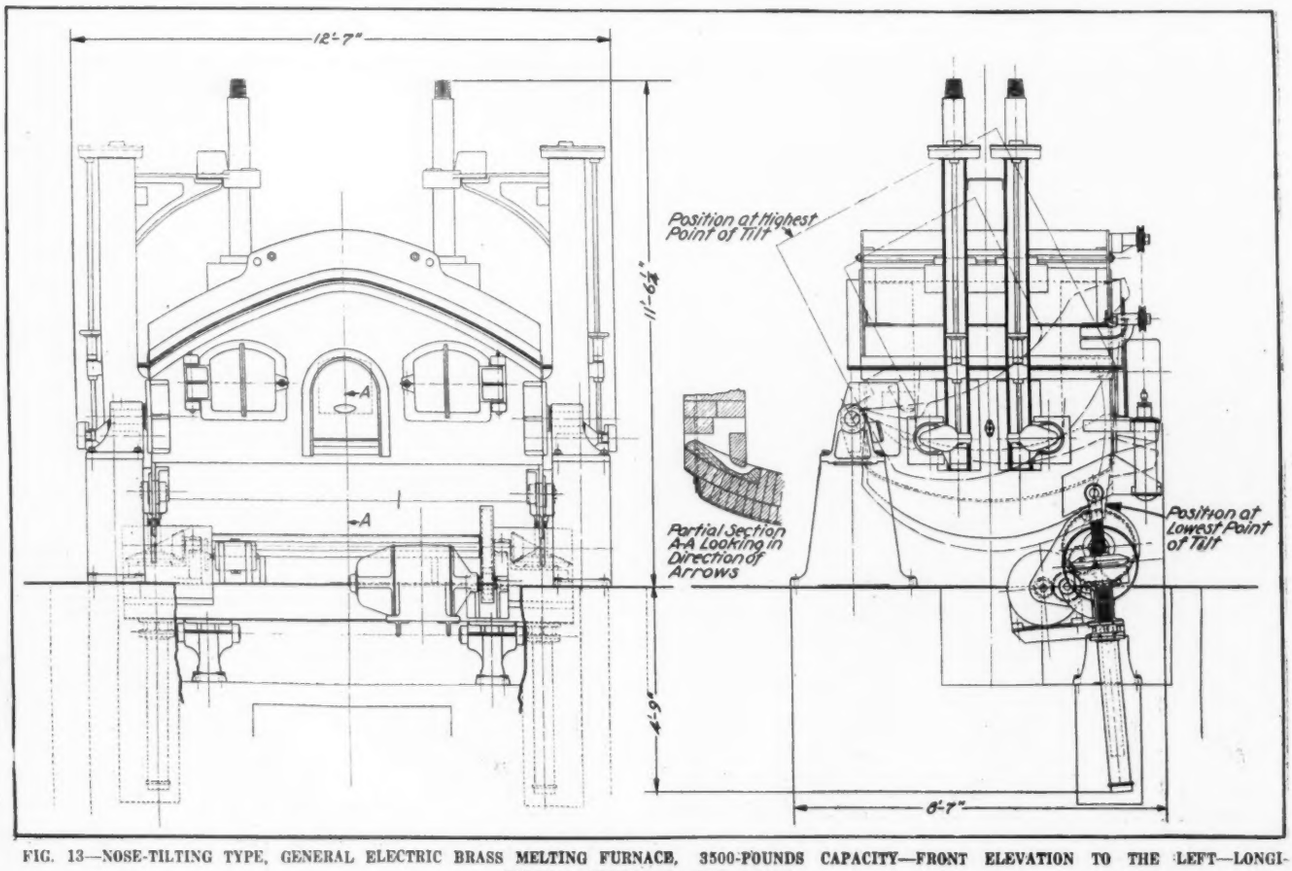


FIG. 13—NOSE-TILTING TYPE, GENERAL ELECTRIC BRASS MELTING FURNACE, 3500-POUNDS CAPACITY—FRONT ELEVATION TO THE LEFT—LONGITUDINAL SECTION TO THE RIGHT

Mfg. Co. for melting Aterite but the users state that as their alloy is a secret one, they will not give out any data.

One General Electric furnace was installed at the United States Copper Products Corp., Cleveland in 1919. This furnace is to be changed over into a nose-tilter, for direct pouring. Other 1¼-ton General Electric furnaces have been ordered by the Ohio Brass Co. and by the Washington navy yard.

The furnace at Cleveland operates 24 hours a day and in that time produces 12 one-ton heats of copper which is poured at 1200 to 1230 degrees Cent. It takes about 1¼ hours to melt and ¾ hour to pour and recharge. There is no determinable metal loss on copper. The power consumption on copper, with the usual delays, is about 550 kilowatt hours per ton, with 24-hour operation. This might be reduced a little by more rapid pouring and charging.

A few heats of 60/40 brass were made in the furnace. These trials indicate that perhaps 18 tons per day could be obtained on yellow brass in 24-hour commercial operation with a power consumption around 300 kilowatt hours per ton. The metal loss on heavy yellow scrap was around 1 per cent. The furnace is said not to work well on light yellow scrap or borings. The rate of power input is probably too great to avoid surface overheating on such material.

The roof has had an average life of 120 to 180 tons when melting copper, on 24-hour operation. The best roof life reported in the Schenectady tests is 350 tons with Hybrand flint brick. The makers expect that the use of corundite will double the life. Of course, a spare roof can be put on fairly quickly when the old one fails. In order to maintain the roof, it is not heat-insulated to any great degree as it must be allowed to radiate heat freely. This cuts down the thermal efficiency of the furnace. Trouble has been met from the metal working through the hearth wall into the resistor. This furnace is the hottest to work around, of all the hearth-type electric brass furnaces the writer has seen in operation. As it runs with the utmost smoothness and with little attention it should be on a par with almost any other type as to labor cost.

The greatest value of the General Electric furnace appears to be in providing a form of electric brass furnace having an electrical load balanced on all phases, free from surges and of a high power factor, which can be used on almost any nonferrous alloy.

The General Electric Co. is developing a variation of this type in which the refractory troubles of the older type are expected to be minimized. In this new type the carbon wearing blocks, in the depressions in which the granular graphite is placed, are held on a ledge running around the inside of a cylindrical furnace. Three vertical electrodes are used, the current being three-phase. The wearing blocks serve somewhat the same purpose toward protecting the bottom of the heating trough in the General Electric furnace, as the trapezoidal resistor does in the suggestion of the Thomson which has been previously cited in this article. The ledge is placed above the metal level so as to obviate the previous troubles due to metal working through the dividing walls between hearth and heating source. The shape of the furnace and the position of the ledge is quite analogous to the shape of the Baily furnace and the position of its heating trough.

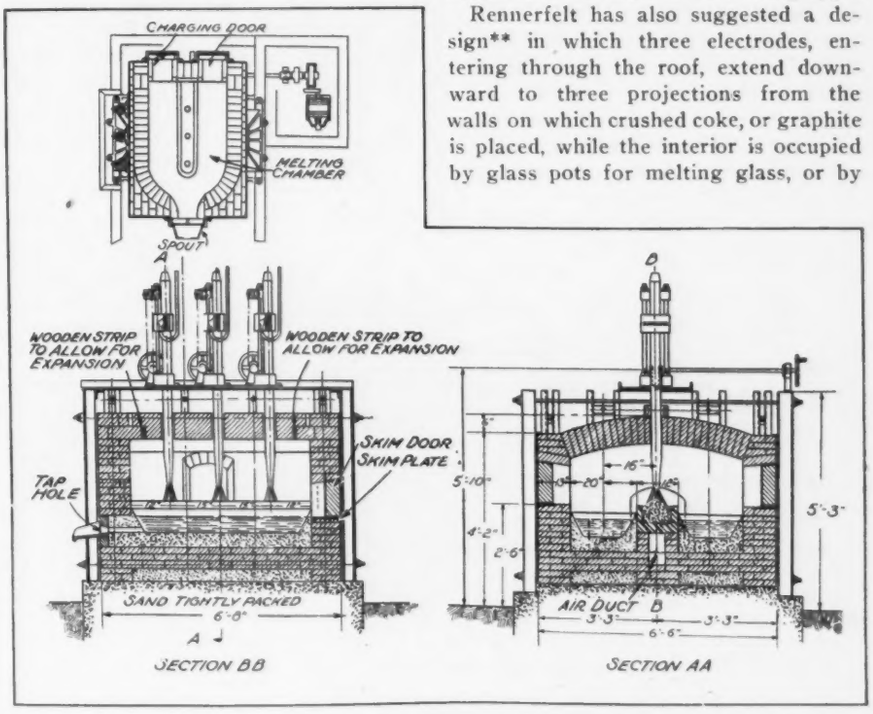


FIG. 15—THREE VIEWS OF THE RENNERFELT REVERBERATORY ELECTRIC FURNACE

An 800-pound furnace of the new General Electric design was scheduled to be given a trial at the General Electric plant about the middle of April. No data on its performance is yet available, nor can the length of the life of the refractory be predicted, though it should be longer than in the older form. A sectional diagram of this furnace is shown in Fig. 14. All these furnaces can be made either to tilt on trunnions, or on the lip. A 600 to 800-pound furnace of this design could be used by small jobbing foundries that have to take power from a central station of such low capacity that single-phase furnaces, particularly those not having a steady load, would not be desirable.

The General Electric furnace, complete with transformers, meters, automatic electrode control, switchboard, etc., was priced in April, 1920, as given in Table 2. It was first advertised for general sale late in 1919.

As the difficulties with the first form of the General Electric furnace seem to lie in the short life of the roof just over the arcs due to the proximity of the roof to the arcs, and in the fact that heating from the sides of the hearth tends to heat hearth and wall equally, the recent suggestion of a Rennerfelt reverberatory furnace* with two hearths and smothered-arc heating trough between them, is of interest. A tapping type of this furnace is shown in Fig. 15. The furnace could also be made of the tilting type.

Rennerfelt has also suggested a design** in which three electrodes, entering through the roof, extend downward to three projections from the walls on which crushed coke, or graphite is placed, while the interior is occupied by glass pots for melting glass, or by a hearth for melting metal. Aside from the difference that Rennerfelt plans to use open-arcs, while the General Electric uses contact-arcs, this scheme is very similar to that used in the latest modifications of the General Electric furnace. The actual development of the Rennerfelt ideas is, however, being made along the lines shown in Fig. 15.

This affords electrical conditions similar to those in the General Electric furnace, but the roof is penetrated by the electrodes at the center of the arch instead of at its base. By this arrangement the heat is generated centrally and would approach internal heating. This furnace would handle two

*Rennerfelt, I., U. S. Patent, 1313834. DeFries, H. A., Rennerfelt Electric Reverberatory Furnace, Chem. and Met. Eng., Vol. 22, 1920, p. 280.

**Rennerfelt, I., U. S. Patent 1305167.

(*Concluded on page* 459)

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Keep The Shop Clean

ONE of the most important essentials in keeping shop equipment in proper condition so that it may be operated to full capacity lies in keeping both plant and machinery in a clean and orderly condition. Cleanliness should be the worker's creed, taught through example and precept by the management. In addition to verbal instructions, signs reading "Keep the Shop Clean", or some similar presentation of the same thought should be posted in prominent places. In this way no one has the excuse of forgetfulness to offer for shirking his duty. Each man operating a piece of machinery should be made to feel that he is held responsible for keeping that unit in a neat and presentable condition as far as the nature of the work will allow. He should know that this is just as important in the eyes of the management as his ability to operate his machine to the limit of its capacity. That the management appreciates a clean and tidy shop at all times should be impressed upon the employe and the men who try to carry out the creed of cleanliness should be commended as freely as those who are delinquent should be censured.

If new employes, especially foreign born and uneducated workmen are put to work in a plant where little attention is paid to order, neatness, or system, the effect upon their work and the care they bestow on the machines they are operating is detrimental. On the other hand, if these men find themselves in a plant where order rules, where castings are piled neatly, gangways are kept clean, flasks are piled in orderly rows, where the floors are clean, windows washed and all machines dusted, wiped, and well oiled, the effect upon their work will be noted at once. System and cleanliness will influence the amount and quality of the work they perform.

A characteristic trait of human nature ordains that a man will give little care to a machine that is covered with dust and dirt, having parts that are allowed to wear with scanty lubrication at spasmodic intervals. However, if the conditions are reversed and if a high standard of neatness and order has prevailed each man will feel that his individual efforts are necessary to maintain this standard. Nothing approaches the pride of a thorough mechanic in a well kept tool or machine. The shining new model car receives better attention and delivers more mileage than the much used victim of several years of rust, road-shock and neglect.

The nature of the work peculiar to foundries presents an extremely difficult problem in keeping the different departments clean and in a presentable condition. Order and system can be maintained only by systemizing the daily work, insisting upon each man doing his share, and by holding each personally responsible for keeping the space he occupies and the machine he operates in a clean and tidy condition. The result in larger and better returns will pay amply whatever trouble is experienced in introducing shop cleanliness.

Several large foundries and quite a number of smaller ones have a certain number of men delegated for the purpose of keeping the floors clean and materials in a tidy condition. In some cases these men are veteran employes who through advancing years or other causes are incapacitated from performing their regular duties, and in this way are pensioned.

Trade Outlook in the Foundry Industry

INDIVIDUAL resourcefulness, called into action by urgent necessity, has served in most centers to establish lines of communication through which the greater number of foundries have secured raw materials despite the continued switchmen's strike. In many cases the castings manufacturers have pooled interests and where local facilities were not available they have rushed through solid trains of coke or iron which has been distributed by trucks from some common siding to maintain operations. Delivery of finished castings, also, has been effected through various means, the consumers in many cases assuming responsibility for delivery by motor truck or waterway shipment.

Stagnation is Regional

The mid-western territory continues in the grip of transportation stagnation, although the condition is slightly improved during the past week. Many foundries in cities which have been embargoed due to the traffic tieup have had iron, sand, or coke billed to an adjacent small town and have built up an express service of automobile trucks to their plants. It has been possible in some cases by freely expending favors to switchmen in intermediate points to expedite the movement of single carload lots of materials, and some larger plants have appointed traffic men to follow each shipment from its source to the plant. With all of this intensive effort, production has only been at a minimum, and in many cases four or five day operation per week has been in force. In New England, embargoes still are in effect over the Boston & Maine and the New York, New Haven & Hartford railroads and difficulty on connecting lines has seriously restricted pig iron delivery. Some foundries in that section have been forced to close. The purchase of iron for immediate delivery pyramiding upon that already contracted has pushed future delivery still further into the background. The demand for castings in that section continues practically unabated.

Prices of Raw Materials for Foundry Use

CORRECTED TO MAY 24

Iron		Scrap	
No. 2 Foundry, Valley	$43.25 to 44.25	Heavy melting steel, Valley	$25.00 to 25.25
No. 2 Southern, Birmingham	42.00 to 44.00	Heavy melting steel, Pittsburgh	25.00 to 26.00
No. 2 Foundry, Chicago	43.00 to 45.00	Heavy melting steel, Chicago	22.50 to 23.00
No. 2 Foundry, Philadelphia	45.60 to 48.10	Stove plate, Chicago	32.50 to 33.00
Basic, Valley	43.00 to 43.50	No. 1 cast, Chicago	42.50 to 43.00
Malleable, Chicago	43.50	No. 1 cast, Philadelphia	37.00 to 39.00
Malleable, Buffalo	46.25	No. 1 cast, Birmingham	30.00 to 33.00
Coke		Car wheels, iron, Pittsburgh	39.00 to 40.00
Connellsville foundry coke	13.00 to 15.00	Car wheels, iron, Chicago	38.50 to 39.00
Wise county foundry coke	12.00 to 12.50	Railroad malleable, Chicago	29.00 to 29.50
		Agricultural malleable, Chicago	29.00 to 29.50

No Relief in Control

Little relief to foundries or iron producers is held in the resumption of wartime control of the railroads by the interstate commerce commission. Even though a priority rule governing transportation is re-established to the fullest extent, food and fuel naturally will rank far ahead of pig iron and foundry raw materials, and the only benefit accruing directly to the castings industry will be the added expedition of all transportation, and the possibility of return haul. The direct return of cars to mines and fuel sources up to the present has aided foundries but little. The coke regions are suffering from a severe car shortage, and congestion at the main transfer points has still further retarded the return of empties. Production has shown a steadily declining curve in the Connellsville region. During the week ending May 15, only 154,400 tons were produced, showing 15,700 tons less than the preceding week, when a loss of 6675 tons was reported. Although a surplus is being accumulated at some ovens, and a net increase in the number of ovens in service is reported, the actual tonnage which is getting through to the consumer is growing smaller, week by week. In the west, the coke situation is worse than at any time since the strike was instituted. Many cars are started, but few succeed in passing terminal points. The coke scarcity extends through to the Pacific coast and is particularly severe in Nebraska, Iowa, New Mexico, Oklahoma and Arizona. Coke prices are fluctuating, rising in some cases to $15, ovens, for prompt delivery. The expectation of higher freight rates is having an effect upon the demand for future delivery. A bill is under consideration, which stands a fair chance of being passed and made effective by Sept. 1, which will provide a sliding scale, whereby the freight rates on coke would be decreased during the period from Feb. 1 to July 31, and increased from Aug. 1 to Jan. 31. General tightening in the credit situation is evident and is having some effect upon foundry business. Requests for deferred delivery upon castings ordered, and in some cases cancellations, have appeared to indicate the reaction which has been noted in many lines. General confidence, and the belief that the present reaction is healthful and presages nothing in the way of a financial or industrial crisis serves to prevent pessimism. However, a feeling is prevalent that a slackening off in demand is due, and that production in the near future will not be so far in arrears. Greater diligence in collection, and a closer scanning of prospective customers' credits is evident. A difference of opinion is expressed as to the possible effect of a decreased demand upon material prices. Some hold that with the present restrictions upon shipments, particularly of iron, stocks later may be thrown upon the market at slightly lower prices when transportation again becomes easier. Automobile makers, in general, are not canceling castings orders, nor are makers of agricultural implements, machine tools, or users of special machine cstings. However, a slight lessening of interest is evident among builders of contractors machinery, consumers of cast iron pipe, and materials used in building construction. Nonferrous activity has been less affected by transportation troubles. Prices of nonferrous metals based on New York follows: Copper, 18.00c; lead, 8.62½c to 8.75c; tin, 52.75c to 63.00c; antimony, 9.00c; aluminum, No. 12 alloy, producers' price, 32.00c, and open market, 31.00c. Zinc is quoted at 7.60c, St. Louis.

Comings and Goings of Foundrymen

FRED ERB, recently elected president of the Detroit Foundrymen's association, has been continuously connected with the foundry industry since he was graduated from the University of Michigan, mechanical engineering department in 1908. Mr. Erb started with the Detroit Foundry Co. as a cupola hand and worked up through the shop until he held the positions of superintendent and foundry manager successively. He left the Detroit Foundry Co. in 1913 and assisted in the organization of the Lakeside foundry, Detroit. Shortly thereafter

FRED ERB

he took a position with the Elmira Foundry Co., Elmira, N. Y., but his interests in Detroit prompted his return to the latter city a short time later when he became superintendent of the foundry division of the Packard Motor Car Co. Mr. Erb was promoted to manager of the foundry division of that company on May 18, 1920. He has been a member of the Detroit Foundrymen's association for the past 10 years and has served as secretary of that body.

John A. Penton, president of the Penton Publishing Co., recently was elected a director of the Wellman-Seaver-Morgan Co., Cleveland, filling a vacancy caused by the death of Samuel T. Wellman.

F. William Richard has resigned as works manager and assistant treasurer of the Columbia Malleable Castings Co., Columbia, Pa.

George Pohl has purchased the interest of J. E. Fogarty in the Keystone Foundry Co., Plymouth, Ind., and henceforth will operate the property himself.

Harry Bill, formerly factory manager of the Winton Motor Car Co., Cleveland, succeeds H. S. Lee, resigned, as factory manager of the Saxon Motor Car Corp., Detroit.

George A. Laub, who for 20 years was affiliated with the American Car & Foundry Co., Berwick, Pa., has assumed his duties as superintendent of the Sligo Iron & Steel Co., Connellsville, Pa.

Emil Horne has resigned as superintendent of the forge and foundry departments of the Packard Motor Car Co., Detroit, to associate himself as head of a foundry being erected in Rochester, Mich.

F. F. Beall has resigned as vice president in charge of manufacturing of the Packard Motor Car Co., Detroit, and is succeeded by E. F. Roberts. Mr. Beall has been elected president of the Gray Motor Co., Detroit.

F. W. Sinram, of the Van Dorn & Dutton Co., Cleveland, was re-elected president of the American Gear Manufacturers' association, at its annual convention at Detroit. This will be Mr. Sinram's fourth term as president.

S. J. Pelton has resigned his position as assistant professor of metallurgical engineering at the University of Cincinnati, Cincinnati, to become metallurgical engineer in the iron foundry of the Lunkenheimer Co., of that city.

E. L. Ramsey, formerly superintendent of the open-hearth department of the American Steel Foundries at its Alliance, O., works, has become associated with the Eastern Steel Co., Pottsville, Pa., in a similar capacity.

William B. Scott, who for five years was superintendent for the Flasher Foundry Co., Nashau, N. H., resigned recently and devoted four months to a trip through Scotland. Mr. Scott on his return became superintendent for the Rodney Hunt Machine Co., Orange, Mass., a position which he held for nine years previously.

Ad J. Hartman, new president of the Pittsburgh Foundrymen's association, is manager of the Frank-Kneeland department of the United Engineering & Foundry Co., Pittsburgh. He has been with that company since 1895, having started in as an office boy in the Frank-Kneeland Machine Co., which subsequently became part of the United Engineering & Foundry Co. He was born in Cincinnati April 19, 1881, coming to Pittsburgh as a boy. He attended the Pittsburgh public schools as well as one of the night technical schools of Pittsburgh. He has been manager of the Frank-

AD J. HARTMAN

Kneeland department of the United Engineering company since 1915.

L. F. Youngs, formerly Michigan sales manager for the Aluminum Co. of America, has been appointed Detroit sales manager for the Aluminum Manufactures, Inc., succeeding Morgan Harding who goes to West Haven, Conn.

H. S. Lee has resigned as factory manager of the Saxon Motor Car Corp., Detroit, and will actively head and manage the H. S. Lee Foundry Co., Plymouth, Mich., of which he is president. Extensions are planned to this foundry which manufactures automobile cylinders and other castings for the motor car industry.

S. A. Whitehouse who has been superintendent of the foundries and

pattern shops of the Western Electric Co., Hawthorne plant, Chicago, for the past 10 years has been made foundry manager for the Des Moines Foundry & Machine Co., Des Moines, Iowa.

Benjamin J. Rivais, formerly core-room foreman for the Brown & Sharpe Mfg. Co., of Providence, R. I., has been made general foreman of the new gray iron foundry erected by the Potter & Johnson Machine Co., of Pawtucket, R. I., manufacturers of machinery and tools.

Carl F. Clark, formerly of the Detroit plant of the Steel Products Co., Cleveland, has been elected president and general manager of the Monroe Steel Castings Co., Monroe, Mich., recently purchased by Detroit interests, who have increased the capital to $300,000 to expand the plant's facilities.

Robert McLaughlin, general superintendent of the Bethlehem, Pa., steel foundry of the Bethlehem Steel Co., recently was presented with a gold watch, chain and charm, as a mark of appreciation from the men with whom he has been associated, some of them for more than 25 years. The inside cover of the watch is engraved with "Presented by the Employes of the Steel Foundry, to one who Plays the Game According to the Golden Rule."

DeWitt V. D. Reiley, formerly vice president, was elected president at a recent meeting of the directors of the Davis-Bournonville Co., Jersey City, N. J. Mr. Reiley succeeds Augustine Davis who resigned last November. Charles B. Wortham, treasurer of the company since its organization, was elected vice president, and William G. McCune was chosen secretary and treasurer.

Charles F. Lederer, until recently superintendent of way of the Milwaukee Electric Railway & Light Co., Milwaukee, has become associated with the rail welding department of the Metal & Thermit Corp., New York. Mr. Lederer entered the track department of the Milwaukee Electric Railway & Light Co. in April, 1908, and was soon promoted to construction gang foreman. In 1904 he was appointed division roadmaster and in 1912 became city roadmaster. In May, 1919, he rose to assistant superintendent, and in September, 1919, became superintendent of way, which position he held until his recent resignation from that company. In these capacities Mr. Lederer obtained much practical experience in rail welding and in the construction of special welded work.

Eastern Founders Discuss Freight Rates

In expectation of a 30 per cent increase in freight rates soon, foundrymen of the Newark, N. J., district are considering the movement by water of at least 40,000 tons of pig iron annually from the Buffalo furnaces to Port Newark. An investigation of this plan has brought out that all of the Buffalo furnaces can ship by water, and that a saving would be effected in the freight rate of approximately $3 a ton, the cost by water being $2.10, as against $5.10 by rail after the expected 30 per cent increase had been put into effect. Moreover, the adoption of this plan would release 1000 cars for other service, the calculation being based on the 40,000 tons of pig iron now being purchased from the Buffalo furnaces. Were the total annual requirements of the Newark district, something like 65,000 tons, used as the basis for calculation, the saving would be 1600 cars.

These facts were presented recently at a joint meeting in Newark of the Newark Foundrymen's association and the Gray Iron club of New York City by C. J. Fagg, traffic commissioner of the Newark board of trade, who has been in charge of the investigation. He asserted that the price of $2.10 a ton would not include haulage from the docks to the plants, and that for this final span of the journey, consumers would have to resort to motor trucks. Should consumers be willing to meet such requirements, the New York Barge canal commission, Mr. Fagg stated, would establish docks at a point along Newark bay and possibly build warehouses for storing pig iron during the winter season, when transportation by water would be impossible. The adoption of this plan was referred to the executive committee of the Newark Foundrymen's association for further consideration.

Considerable attention was devoted at this meeting to the subject of foundry costs, and with the aim to bring out a full discussion, the executive committee of the Newark association previously had mailed to every member a blue print of a gray iron casting with a request for quotations, based on the weight and quantity specified. This request resulted in the presentation of quotations by a number of the foundries, the bids being read at the meeting along with the names of the bidders.

The discussion following centered around the remarks of Andrew N. Petersen, president of the Brooklyn Foundry Co., Astoria, L. I., and head of the Gray Iron club of New York City, who presented data which he thought might serve as a basis for ascertaining as nearly as possible a uniform cost system. This data, he asserted, formed the text of a cost card which he had compiled and which now was in general use by members of the Gray Iron club. The members of the Newark association passed a resolution requesting Mr. Petersen to forward to each of them one of these cards. Some members expressed the opinion that the association at a relatively early date would take official action in adopting Mr. Petersen's method, or something similiar.

All officers of the Newark association were re-elected for the ensuing year as follows: President, A. E. Barlow, Barlow Foundry Inc., Newark, N. J.; vice president, George Krouse, Jersey City, N. J.; treasurer, John Campbell, Flockhart Foundry Co., Newark, N. J., and secretary, P. A. Smith, A. P. Smith Mfg. Co., East Orange, N. J. C. O. Klockars, Essex Foundry Co., Newark, was elected to succeed Paul Debevoise on the executive committee.

Stove Manufacturers Meet in Boston

Stove manufacturers from throughout the country met in Boston during the week of May 10 to attend the annual convention of the National Stove Manufacturers' association. Lee W. VanCleve of Buck's Stove & Range Co., St. Louis, was elected president and Robert S. Wood of Troy, N. Y., secretary at the closing session. Following the business meeting on Wednesday, May 12, Robert Denham of the Denham Cost Finding Co. presented a paper on the method of charging individual machine overhead. Mr. Denham states that a charge based on the labor cost is unfair inasmuch as a $6 man might operate the machine on as great a production basis as a $12 man. He maintains that the time of operation of each machine is the best basis for charging overhead. If the total overhead for any group of machines is established, during a period of definite time operation, then the total charge divided by the total time, gives a basis for making future charges against machines. Wednesday afternoon Charles E. Parlin of the Curtis Publishing Co. presented an excellent paper on present day industrial conditions. The buying movement in the fall of 1919 is of particular interest in any analysis of the situation, stated Mr. Parlin. Our exports did not materially increase, our largest industrial consumers did not purchase and yet suddenly manufacturing plants found themselves swamped with orders. Mr.

Parlin believes that this activity largely was due to a buying movement among farmers, who with the prosperity gained through huge receipts for produce in the last three or four years, suddenly realized that their money would buy them new equipment, new houses and new luxuries. As long as the farmers are prosperous, according to Mr. Parlin, the country will not have a widespread slump. With agricultural production less than normal and the needs for food throughout the whole world above normal, prices are going to remain high and farmers are going to continue to be an important buying factor in the country.

Addresses the Pittsburgh Foundrymen

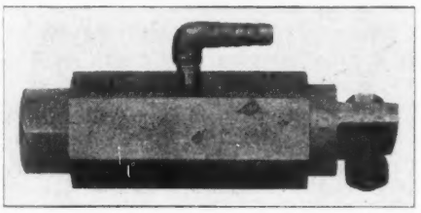
W. E. Moore, of the Pittsburgh Electric Furnace Corp., addressed members of the Pittsburgh Foundrymen's association at a meeting held May 17 at the Chatham hotel, Pittsburgh. His subject was "Rapid Type of Electric Foundry Furnaces." The speaker mentioned the advantages and economies of melting gray iron, malleable iron, steel and brass in electric furnaces of the rapid heating type. Mr. Moore concluded his paper with steropticon views of the various types of electric furnaces showing in detail the wiring equipment and control systems. The by-laws of the association were amended so that hereafter officers will assume their positions following the June meeting each year instead of in September, as was the case under the old by-laws. The officers elected for the ensuing year are as follows: President, A. J. Hartman, United Engineering & Foundry Co.; vice president, F. H. Clay, Allegheny Steel Co.; treasurer, William J. Brant, McCoy-Brant Machinery Co.; secretary, Bayard Phillips, Phillips & McLaren Co.; executive committee: J. S. McCormick, J. S. McCormick Co.; H. P. Spilker, Sterrett-Thomas Foundry Co.; John Field, Union Steel Casting Co.; John W. Gray, Fort Pitt Steel Casting Co., and A. M. Fulton, formerly of the Fort Pitt Malleable Iron Co.

Car Manufacturers Meet

The second annual meeting of the industrial car manufacturers was held in Pittsburgh recently, at which time Col. James Milliken was re-elected president and H. M. Wey was again chosen as secretary. The following were elected as directors: Lion Gardiner, vice president, The Lakewood Engineering Co., Cleveland, chairman; N. A. Doyle, vice president, American Car & Foundry Co.; W. E. Farrell, president, Easton Car & Construction Co.; J. M. Hansen, president, Standard Steel Car Co.; J. R. Kilbourne, vice president and general manager, Kilbourne & Jacobs Mfg. Co.: R. J. Magor, president, Magor Car Corp.; and J. C. Shirer, president, Star Mfg. Co.

Testing Society To Hold Convention

The American Society for Testing Materials has been so accustomed to holding its annual meetings at Atlantic City that this resort almost has become looked upon as a fixed meeting place for the society. However, this year the society has selected Asbury Park, N. J., for the place of its annual meeting from June 22 to 25 inclusive. Three sessions will be held on the first and third days, while for the second and fourth days only two sessions have been arranged. The iron and steel sessions will occupy the first portion of the program and the subjects of cement,



NEW TYPE AIR ACTUATED VIBRATOR

concrete, ceramics and allied materials will be considered at the latter part of the meeting, beginning with the Thursday evening session. A paper on malleable iron by H. A. Schwartz will be presented at the session Tuesday afternoon, and on Thursday afternoon reports of the committees on coke and on the method of sampling and analysis of coal will be given.

Detroit Meeting Shows Foundry Expansion

The annual banquet of the Detroit Foundrymen's association, held on the evening of Thursday, May 13, at the Fellowcraft club, Detroit, was unusually well attended and reflected the tremendous growth of that city as a foundry center due to the great development of the automobile trade in that district. "The Parable of the Sentinel" was the title of a toast responded to by Mr. Schemerhorn.

At the business session officers for the ensuing year were elected as follows: President, Fred Erb, superintendent foundry division, Packard Motor Co.; vice president, J. C. Woodison, E. J. Woodison Co.; secretary, J. R. Brady, Aluminum Manufactures, Inc., and treasurer, J. C. Stewart, General Aluminum & Brass Co.

Bill is Impressed by an Automobile Shop

(*Concluded from page* 437)

by the use of standard gages. Having passed inspection they are sent to the molding floor. The volume of business done by the company may be gaged from the fact that their monthly sales amount to $250,000. To take care of and look after the detail incident to a business of such proportion there is an office staff of only eight persons.

"This brings us back to where we started viz.: that power, knowledge, and organization spell Efficiency. Any man can gain knowledge, with knowledge he can build up an organization; but power is a matter of individuality, a gift if you will. It can neither be acquired nor transmitted. It properly may be regarded as the principal or senior member of the trinity. It is the germ which brings life to the other two; and having brought life, proceeds to sustain and develop that life to the highest point. All of which is respectfully submitted for your consideration. There may be a moral in it and then again there may not. 'You pays your money and you takes your choice.'"

"I wish I had known all that thirty years ago," I said. "I might have learned to become a ball player instead of a molder."

Develops New Vibrator

The Hanna Engineering Works, Chicargo, manufacturer and distributor for the Mumford Molding Machine Co., has developed a new type of unbalanced vibrator. The body of this vibrator and its component parts are made of a high grade steel. The piston carries the air in a storage reservoir which is in constant communication with the air line for instantaneous delivery to the ends of the cylinder through large milled openings. All plugged holes in the cylinder have been eliminated. A nonstalling feature has been incorporated, which insures starting the vibrator by merely opening the air supply valve. The blow may be controlled for various molding conditions by throttling the air pressure.

Large air passages have been provided, which contribute materially to the longevity of the device. Heads and caps are so constructed as to eliminate the distortion of the bodies when screwed together.

The Piston Foundries, Inc., Minneapolis, recently have been organized and will assume the obligations of the foundry department of the Farm Motors Co., that city.

Obituary

Frank J. Becker died recently at Mercy hospital, Hamilton, O., at 56 years of age. Mr. Becker, who was vice president and general manager of the Peerless Foundry Co. during 15 years, when this concern was located at Hamilton, was a practical foundryman of over 20 years experience. He was trained as a practical patternmaker and at one time operated a small pattern shop of his own. Recently he was president of the New Foundry Appliance Co., Trenton, O., an office which he occupied for four years. Mr. Becker invented many devices applicable to farm implements, particularly various parts for corn planters, and he also invented a patent molding frame. He was actively identified with civic and community betterment plans of his local city.

FRANK J. BECKER

Jay S. Young, production manager of the Detroit Foundry Co., Detroit, died in Harper hospital, May 3, from shock following an operation. He had been ill all winter. Mr. Young was a member of the Detroit Foundrymen's association and Westminster church. He is survived by his widow, Mrs. Julia Carter Young, and five children, Alden, William, Robert, Donald and Martha.

Electrical Melting of Alloys—VII

(*Concluded from page* 453)

different alloys in two separate hearths at the same time, if desired. Automatic control can be used, as in the General Electric furnace.

In the design shown in Fig. 15, the two hearths are in contact with the heating trough. Therefore, the same danger of metal penetrating through a crack and entering the resistor, that was met in the old form of the General Electric furnace, is present.

A cooling duct directly under the carborundum heating trough is also shown. There seems to be too much possibility of a break-through from the hearth into this duct. The writer would prefer to replace the duct and the brick supports for the trough by a carborundum brick wall between the two hearths. Carborundum bricks supporting the trough itself could be spaced on this wall. He would also locate the hearths lower in the furnace so that the metal level is below the heating trough. It should then be possible to replace a damaged trough without tearing out the whole hearth structure. Various points of the design need experimental trial and development. It seems likely that when such experimental work has been done, this form of furnace will avoid many of the drawbacks of the Baily and the General Electric furnaces, having better thermal efficiency than either, using three-phase power if desired, thereby overcoming one limitation of the Baily furnace, and probably having better chances for long life of the refractories than the General Electric furnace.

Another Furnace Being Designed

The Industrial Electric Furnace Co. is working on a furnace which has not yet been described. It is said to be a self-regulating three-phase furnace applicable to brass and bronze. At present the 250-pound size furnace is under experimental development. While the type under which these furnaces fall is not known, the furnace is mentioned here because it uses polyphase power, like the General Electric and Rennerfelt reverberatory furnaces.

On account of the necessary heat storage in the roofs and linings of all the reverberatory, reflected-heat or overhead-resistor furnaces, they will all be at some disadvantage on single-shift operation and will be at their best under continuous operation. None of them are very attractive in small sizes, save where a small three-phase furnace is called for by the electrical conditions. All these furnaces, at least in the present commercial forms, must be charged from the side. Therefore, effective overhead automatic charging is out of the question.

The wide commercial use of the Baily furnace shows that there is a field for furnaces of this general type. Considerable advance over the forms of this type so far commercially used is possible, and both the Thomson and the Rennerfelt reverberatory furnace deserve thorough trial, though neither has yet progressed beyond the experimental stage.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The Gray & Dudley Co., Nashville, Tenn., has a permit to erect an addition to its foundry.

The F. & H. Foundry Co., Newark, N. J., is having plans drawn for the erection of a plant.

The Lincoln Brass Works, Detroit, has increased its capital from $15,000 to $75,000.

The core room and foundry of the Vulcan Plow Co., Evansville, Ind., recently was damaged by fire.

The Sydney Foundry & Machine Co., Sydney, N. S., plans to make improvements to its plant.

W. F. Vilas Co., Cowansville, Que., is having plans prepared for the erection of a foundry.

The Early Foundry Co., Dickson City, Pa., contemplates the erection of a foundry, 90 x 200 feet.

The Michigan Gray Iron Castings Co., Detroit, plans the erection of a plant addition.

The Falcon Bronze Co., Youngstown, O., recently increased its capital from $25,000 to $200,000.

The machine shop and foundry of O. V. Smocker & Sons, St. Johnsbury, Vt., recently was damaged by fire.

Contracts have been awarded by the Loeffler Machine Co., Sheboygan, Wis., for the erection of a gray iron foundry, 40 x 180 feet.

The Stark Foundry Co., Canton, O., recently was incorporated with a capital of $50,000, by E. E. Miller, J. Goldatti, F. C. Miller and others.

The Metal Trades Foundry Corp., Alameda, Cal., contemplates the erection of an addition to its plant.

Henry E. Pridmore, 1901 South Rockwell street, Chicago, is having plans drawn for the erection of a foundry, 60 x 160 feet.

The Railway Materials Co., Stevens Point, Wis., which operates a malleable foundry, is enlarging its plant. W. M. Simpson, Chicago, is president.

Enot Foundry Co., Wayne, Mich., recently was incorporated with a capital stock of $500,000, by John Enot and others.

The Aurora Foundry Co., 375 Spruce street, Aurora, Ill., is building an addition to its plant, 48 x 100 feet.

Capitalized at $10,000, the New England Castings

Co., Worcester, Mass., recently was incorporated by Edwin W. Lynch and others.

The Hagerstown Foundry Co., Hagerstown, Md., plans improvements to its plant.

The Ashland Foundry & Machine Shops, Ashland, Ky., recently was damaged by fire.

The Warrior Foundry & Machine Co., Tuscaloosa, Ala., contemplates the erection of a foundry, 60 x 72 feet, and a machine shop, 60 x 82 feet.

The Acme Malleable Engineering & Boiler Works Co., Limoilou, Que., has awarded a contract for the erection of a foundry.

Plans are being prepared for the erection of an addition to the plant of the Callander Foundry Co., Guelph, Ont., of which H. B. Callander is manager.

Booth-Coulter Copper & Brass Co., 115 Sumach street, Toronto, Ont., let a contract for the erection of a plant addition.

Architect J. Landis, Highland and Franklin streets, Conderton, Pa., is preparing plans for a foundry, 20 x 40 feet. The owner's name has been withheld.

The Rome Brass & Copper Co., Rome, N. Y., has increased its capital from $1,600,000 to $5,000,000.

Erection of a small foundry unit at the plant of the Wisconsin Iron & Wire Works, Milwaukee, has been practically completed.

The Midland Brass Works, Ft. Worth, Tex., has been incorporated with a capital of $25,000, by J. L. Boicourt, Arthur D. Modgson and W. B. Sloan.

The Worcester Foundry Co., Inc., Worcester, Mass., plans the erection of an addition to its plant, 50 x 150 feet.

Capitalized at $5000, the Ideal Foundry Co., Philadelphia, recently was incorporated by W. F. Baer, David H. Kinley and others, to engage in a general foundry business.

Erection of a foundry, 100 x 120 feet, for the Ft. Dearborn Mfg. Co., Sterling, Ill., is progressing, and it is expected the building will be ready for occupation about July 1.

The A. J. Detlaff Co., Detroit, is erecting an addition to its brass and aluminum foundry, which when completed will practically triple the company's floor space.

Production is expected to be started about July 1, by the Newman Foundry, Kendallville, Ind., a new organization which will engage in the manufacture of gray iron castings.

The Clifford Brass & Copper Co., New York, recently was incorporated with a capital of $50,000, by H. and H. S. Sack and M. I. Rappaport, 365 Myrtle avenue, Brooklyn, N. Y.

Capitalized at $75,000, the Springfield Finished Castings Co., Springfield, O., recently was incorporated by T. R. Ludlow, J. Turner, T. W. Ludlow, W. E. Showalter and others.

The Ontario Foundry Co., Ltd., Toronto, Ont., recently was incorporated with a capital of $40,000, by Peter Kirkegaard, 33 Indian road, William W. Parry, Horace B. Proudlove and others.

The Kokomo Malleable Iron Co., Kokomo, Ind., has been incorporated with a capital of $350,000, by Edward Bridges, M. Cook, A. G. Seiberling and J. W. Johnson.

The Central Pattern Works, 10 Ardsley court, Newark, N. J., recently was incorporated with a capital of $125,000, by A. F. Blasius, Joseph Darche and F. W. Finsbach.

The Hope Foundry & Machine Co., East Orange, N. J., has been incorporated with a capital of $125,000, by H. H. Picking, F. E. Lynch and others.

The Hatboro Foundry Co., Hatboro, Pa., recently was incorporated with a capital of $50,000, by Willis W. Wilgus, Albert E. Koch and Melvin W. Stryker.

Gray iron and semisteel castings will be manufactured by the St. Joseph Foundry Co., St. Joseph, Mich., which was recently incorporated with a capital of $10,000, by John Kultgen and others.

The Plymouth Foundry & Machine Co., Plymouth, Wis., is gaining additional capacity by the acquisition of the old city hall building, which will be remodeled into offices and warehouse.

Articles of incorporation have been filed by the Western Eagle Mfg. Co., Racine, Wis., with a capital of $50,000, to manufacture wood and metal patterns, by M. Peterson, J. Diehl and E. J. Albert.

Capitalized at $500,000, the Toronto Castings, Ltd., Toronto, Ont., has been incorporated to manufacture castings, etc., by F. A. Dewey, 7 Aberdeen avenue, Henrie G. Smith, room 44, 2 Toronto street, and others.

The Gunning Iron & Brass Foundry, Inc., New Bedford, Mass., has been incorporated to operate a foundry and machine shop, with a capital of $50,000, by Andrew Gunning, John B. Lowney, H. L. Potter, George R. Dahn and others.

Sanitary pipe and fittings as well as general castings will be manufactured by the Birmingham Pipe & Fittings Co., Birmingham, Ala., which is completing the erection of a foundry building, 75 x 250 feet, and a machine shop, 60 x 150 feet.

The Walker-Stewart Foundry Corp., Meriden, Conn., recently was incorporated with a capital of $50,000, by Victor E. Walker, Amos Doolittle, John J. Roach, Henry E. Bradshaw and William Stewart, Torrington, Conn.

The Glass-Arthur Iron & Brass Foundry, Gastonia, N. C., has completed the erection of a foundry building, 40 x 70 feet, but now is planning to erect a pattern shop, this improvement to be undertaken within the year.

The Interstate Pattern Co., Milwaukee, has been incorporated with a capital of $15,000, by A. G. Hensel, James T. Gregerson and Edwin Christiansen. The company contemplates the erection of a pattern shop.

Operating under the name of the Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., the Benton Harbor Forging Co. now has been capitalized at $200,000 and becomes a separate company, although the officials are the same as for the malleable iron company.

The Turner Mfg. Co., Port Washington, Wis., conducting a large gray iron foundry, machine shops, and a gas engine and tractor works, has let the contract for the erection of a foundry building, 60 x 150 feet, a machine shop addition, 40 x 60, and other improvements.

Work has been completed on the erection of the structural steel for the foundry of the Walker Machine & Foundry Corp., Roanoke, Va. This building, which will be 60 x 100 feet, will be equipped with modern machinery, practically all of which has been ordered. The company will manufacture commercial gray iron castings.

Temporary repairs have been made to the foundry of J. & W. Jolly, Inc., Holyoke, Mass., which was recently damaged by fire, but the firm is having plans prepared for the erection of a new foundry building, which will be erected over the present structure. The company will be in the market shortly for a 5-ton electrical crane and other foundry equipment.

Orders have been placed for core room, molding machine and sandblast equipment to triple its output, by the Monroe Steel Castings Co., Monroe, Mich. It will utilize its present plant capacity and does not contemplate the erection of additions at present. It recently increased its capital from $100,000 to $300,000 and changed its practice from crucible to electric furnace.

The Lloyd Mfg. Co., Menominee, Mich., manufacturing looms for weaving reed furniture, etc., is planning to establish a branch plant in London, England, to handle foreign trade. Estimates are being taken for a 3-story building, 100 x 400 feet, which will house a foundry, machine shop and assembling floor. Marshall B. Lloyd is president and general manager.

The Ypsilanti Hay Press Co., Ypsilanti, Mich., has sold its plant to the Ypsilanti Foundry Co., an organization made up of the owners of the foundry operated by the Central Specialty Co., Detroit. Piston rings will be the principal product in connection with light automobile castings. The present shop, employing 30 molders, will be enlarged. J. H. Lonskey is manager.

The Oliver Machinery Co., Grand Rapids, Mich., recently purchased the foundry heretofore operated by the Grand Rapids Foundry Co., which it will continue to operate under the old name. The company has purchased a 10-ton crane and has contracted with the H. M. Lane Co., Detroit, to redesign the building. Necessary equipment needed, includes an additional air compressor and several molding machines.

The Liberty Foundry Co., Inc., 1831 Centre Line avenue, Detroit, recently increased its capital from $25,000 to $100,000 and now is erecting a foundry building. This building will be modernly equipped, but for the present the only equipment needed and for which the company is in the market, consists of a tumbling barrel and a used positive pressure blower with sufficient capacity for a cupola lined to 48 inches inside diameter.

The capital stock of the Air-Friction Carburetor Co. Dayton, O., recently was increased to care for the expansion of the company's business. Part of the increase will be used for financing the erection of a new building, which will be equipped with screw machines, punch presses, milling machines, drills, etc., for which the company will be in the market. The company will engage in active foundry business later.

The foundry capacity of the Marshall Furnace Co., Marshall, Mich., has been increased 50 per cent, and additional plans now are being prepared for the erection of another addition, for which the company will be in the market for foundry and pattern shop equipment, as well as some machine shop and cleaning room apparatus. The company recently increased its capital from $150,000 to $300,000.

Erection of a small addition to the main foundry building of the Fairmount Foundry & Engineering Works, Woonsocket, R. I., is under way. This extension, which will be used to increase the core room capacity, will be 40 x 43 feet. In addition to this building the company also is erecting a machine shop and pattern storage building, one story, 54 x 110 feet. Practically all necessary equipment has been ordered.

Succeeding the Phoenix Iron Works, Inc., the Phoenix Iron & Foundry Corp., Phoenix, N. Y., recently was incorporated with a capital of $25,000. A building has been remodeled and equipped for a plant and operations are expected to be started shortly. Daily capacity at first will be about five tons of gray iron castings. W. A. Markwick is president and treasurer; F. S. Drohan is vice president and E. C. Ryan is secretary.

Capitalized at $125,000, the Detroit Piston Ring Co., Detroit, has been incorporated and has purchased a plant from the National Foundry & Machine Co., Plymouth, Mich., in which it plans to manufacture piston ring castings. This building is equipped except for necessary piston ring casting equipment. Officers of the company are: President, John Magee; vice president, J. Martin, and secretary-treasurer, Harry Magee. The main office of the company is at 7401 Richmond avenue, Detroit.

Portable motors and other power equipment will be manufactured by the Hydraulic Machinery Mfg. Co., Port Neches, Tex., a company which is now being organized with a capital of $250,000. Officers of the company who are, president, C. F. Holmes, secretary, A. H. Dewer, and treasurer, R. C. Cogburn, state that it will be some time before it will be in the market for equipment. It has plans for a plant to consist of a foundry, plate shop and machine shop.

Capitalized at $10,000,000, the Dominion Engineering Works, Ltd., Montreal, Que., has been organized to take over as a going concern the Dominion Engineering & Machinery Co., Ltd., which was organized some time ago to assume operation of the paper machinery department of the Dominion Bridge Co., Ltd. The new organization is operating in a shop built some years ago for the St. Lawrence Bridge Co., Ltd., and this building is being equipped as a heavy machine shop and a foundry is being added. The company manufactures paper-making machinery, hydraulic turbines, etc., and has arranged to manufacture in Canada hydraulic machinery of the William Cramp & Sons Ship & Engine Building Co. The officers of the company are: President, G. H. Duggan, and secretary, R. Montague Davy.